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ABSTRACT

As one of four volumes in a K-12 series, this teaching guide contains classroom and outdoor activities pertaining to the environment and energy for kindergarten through third grades. The guide was developed based upon the understanding that environmental education can serve as an instructional umbrella covering many topics (conservation, marine education, city planning, population, etc.) and that it is not a specific subject but an interdisciplinary theme. The activities are organized around four major topics: natural environment, built environment, social institutions and decision making, and energy and environmental resource management. Each section begins with a summary of issues related to that topic followed by a listing of major concepts and their associated objectives. One activity is presented to teach each objective (approximately 40). Objectives correspond with those contained in the California "Course of Study" guide for 1981-84. Each activity provides a brief description, the objective, purpose, time, topics, location, materials, lead-up and preparation procedures, and follow-up activities. Appendices list the sources for the activities, California resource agencies, and teaching materials available from these agencies. In the beginning of the guide, a procedure is outlined for planning an environmental education program. (DC)

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ENVIRONMENTAL EDUCATION GUIDE

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Environmental Education Guide
Volume 1

An Environmental/Energy Education Primer for Kindergarten through Grade Three
1981 - 1984

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In cooperation with the California State Department of Education
Wilson Riles, Superintendent of Public Instruction

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Joint Policy Statement
Environmental/Energy Education

California's abundant varied and productive natural resources coupled with a high degree of environmental quality have enabled our citizens to live highly rewarding and productive lives. Successful continuation of a high quality of life for us all depends upon how well we conserve, manage, and utilize energy and natural resources and safeguard our environment.

Wise resource and environmental management involves the intelligent cooperation of governmental resource management agencies, private industry, and concerned and informed citizens acting individually or through their elected and appointed officials.

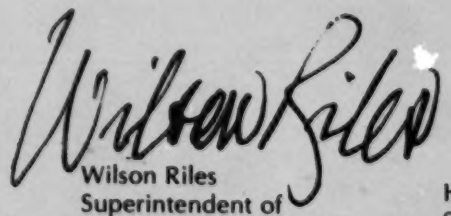
Intelligent and effective citizen participation in resource and environmental conservation requires knowledge in a number of areas, including the sciences, social sciences, and humanities. It requires the development of skills which enable each person to live in a manner which supports environmental quality. It involves commitment to get involved and work for a better life for all Californians now and in the future.

Our schools play a key role in the development of what amounts to an informed public environment ethic.

Instruction must be provided at all grade levels and in all appropriate subject matter areas. Outdoor learning experiences should be provided and full use should be made of services, materials, and expertise offered by resource management agencies, citizen conservation associations, businesses, industries, and others. Teachers must understand the importance of their role in environmental education, possess the necessary knowledge and skills in this area of instruction, and be provided with adequate instructional materials and equipment.

The Department of Education and the Resources Agency share responsibility for encouraging the development and maintenance of an effective environmental/energy education program for the schools of California. In recognition of this responsibility, we, the Superintendent of Public Instruction and the Secretary for Resources, agree to provide appropriate services, materials, and expertise to the schools and to coordinate our efforts in a statewide program.

We further urge educators and resource management personnel at all levels to work together for the benefit of the most precious resource of all, the youth of California.



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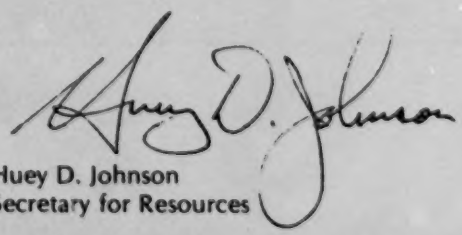
Public Instruction



Huey D. Johnson
Secretary for Resources

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The project manager and staff would like to express their appreciation for the professional contributions of the many environmental educators throughout the state.

We owe an enormous debt to our colleagues whose assistance throughout the entire development of this curriculum guide made it possible to move to the next developmental phase. Each phase required a particular kind of expertise and the California environmental education community responded admirably. Rudy Schafer, Environmental/Energy Education Coordinator for the State Department of Education, provided the principal leadership for the development of this Guide. He worked very closely with us throughout the entire project, providing valuable environmental education curriculum materials from California, throughout the United States, and many foreign countries. His support and encouragement were most appreciated.

Esther Railton, Director of Environmental Education at California State University, Hayward, was the principal consultant for the development of the environmental education conceptual framework. Her background, reputation, and experience in environmental education were invaluable to the project team. Upon completion of the environmental education framework, a group of environmental educators from throughout the state were invited to a workshop at the Asilomar Conference Center for the review, critique, and modification of the suggested framework's goals (concepts) and objectives, which were developed under Dr. Railton's guidance. The following people participated at the Asilomar workshop:

Bill Baker
Alameda County Superintendent of Schools
Hayward

Dorothy Bjur
University of Southern California
Los Angeles

Edith Carlston
Pittsburg Unified School District
Pittsburg

Grant Cary
Laurel Ecology Center
Van Nuys

Cheryl Christiansen
Humboldt County Office of Education
Eureka

Jack Davidson, *Los Angeles County Superintendent of Schools*
Downey

Teresa DeBono
Alameda County Superintendent of Schools
Hayward

Bob Flasher
The Oakland Museum
Oakland

Ron Fontaine
Kern High School District
Bakersfield

John Harter
School of Education
University of California, Berkeley

Marlynn Kaake
Lincoln Middle School
Alameda

O. E. Leaf
Department of Conservation
Sacramento

Nat Pearson
Alameda County Superintendent of Schools
Hayward

Gloria Refuerzo
Highlands School
Pittsburg

Robert Ryan
California State Department of Education
Sacramento

Rudy Schafer
California State Department of Education
Sacramento

Barbara Steinberg
Marin County Office of Education
San Rafael

Bruce Stewart
Moss Landing Marine Laboratory
Moss Landing

Vince Vandre
Department of Fish and Game
Sacramento

Debra Voss
Solid Waste Management Board
Sacramento

Randy West
La Vista High School
Orangevale

Molly Whitely
Napa Junction School
Napa

The next major task of the project team was to form a research team to review curriculum programs, guides, and materials from throughout the country to determine what environmental education activities matched the concepts and objectives of the environmental education framework. The following individuals tenaciously pursued this task until activities were matched to each objective of the framework:

Kathryn Slichter
Friends of the Earth
San Francisco

Alice Watt, Research Assistant
California State University
Hayward

Carolie Sly
Environmental Education Consultant
Berkeley

Abby Zurier
Environmental Education Consultant
Palm Springs

Teachers and curriculum experts from all over the state were then selected to review the activities the research team had chosen to determine the best and most appropriate activities for each of the environmental education objectives. There were four such workshops and the following people were involved:

Jeanette Biasotti
Rancho Romero School
Danville

Jerry Bishop
Castro Valley High School
Castro Valley

Lee Boyes
Egling Middle School
Colusa

Maxine Burnworth
Parkside School
Pittsburg

Edith Carlston
Pittsburg Unified School District
Pittsburg

Evelyn Cormier
Brookvale School
Fremont

Sam Dederian
Galileo High School
San Francisco

Linda DeLucchi
Lawrence Hall of Science
Berkeley

Gail Faber
Rancho Romero School
Danville

Bert Felton
Rancho Romero School
Danville

Joe Fontaine
Kern High School
Bakersfield

Phil Gordon
Rancho Arroyo Junior High School
Hayward

Joe Hamilton
New Haven Unified School District
Union City

Gary Heath
Lawrence Hall of Science
Berkeley

Toris Jaeger
Orinda Unified School District
Orinda

Marlynn Kaake
Lincoln Middle School
Alameda

Marcia Batcheller-Kallison
Piedmont Middle School
Piedmont

Margaret Kelley
Coyote Hills Regional Park
Fremont

Sylvia Kendzior
Rancho Arroyo School
Danville

Kathy King
Logan High School
Union City

Dallas LaBlanc
Southwood Junior High School
San Francisco

Carol Libby
Loma Vista School
Vallejo

Rich Lohman
Albany High School
Albany

Helen McKenna
Washington High School
San Francisco

Larry Malone
Lawrence Hall of Science
Berkeley

Anne Manolis
Sacramento City Unified School District
Sacramento

Nancy Olson
Pittsburg Unified School District
Pittsburg

Erma Owens
Garfield School
Oakland

Lynne Porteous, *Fort Funston*
San Francisco Unified School District
San Francisco

Esther Railton
California State University
Hayward

Gloria Refuerzo
Highlands School
Pittsburg

Karen Reynolds
Oakland Unified School District
Oakland

Melva Rush
Thornton Junior High School
Fremont

Helga Schwab
Earhart School
Alameda

Marilyn Shaver
Bel Air School
Pittsburg

Phyllis Shuck
Olive School
Novato

Sylvia Smith
Pittsburg Unified School District
Pittsburg

Barbara Steinberg
Marin County Office of Education
San Rafael

Ray Watson
Walters Junior High School
Fremont

Randy West
La Vista High School
Orangevale

Molly Whitely
Napa Junction School
Napa

Bev Wu
Lakeview School
Oakland

When the teacher workshops were completed, we discovered that there was a need to revise and adapt many of the activities to match the objectives more closely. In some cases, the teachers felt that none of the activities they had reviewed was appropriate or acceptable; this required developing original classroom activities. The majority of the writing was done by Larry Rose, San Francisco environmental and energy education consultant, and Carolie Sly. In addition, Carolie had the delicate responsibility of coordinating the efforts of the writing team. The following people also contributed to the writing efforts and to them we owe a debt of gratitude:

Bob Flasher
The Oakland Museum
Oakland

Gary Heath
Lawrence Hall of Science
Berkeley

Marsha Kallison
Piedmont Middle School
Piedmont

Larry Malone
Lawrence Hall of Science
Berkeley

Steve Wilkes
Anna Kirchgater School
Sacramento

Molly Whitely
Napa Junction School
Napa

Randy West reviewed the California State Resource Agencies materials, selected those that were appropriate for classroom use, and matched those materials to the major areas of concern.

Without Shelle Bolar, Maycelle Elliott, Bonnie Halligan, Marie Perez, and Dorothy Vallerga — secretaries in the Instructional Support Services Unit — who spent endless hours typing this Guide, it never could have become a reality.

The drawings in this Guide are those of Louis LaBrie, Oakland artist. And finally, thanks to John O'Lague and his Publications Services staff, Douglas Arthur, Salvador Cortez, Linda Henderson, and Cindy Price, for editing, designing, and typesetting the Guide.

This Guide has truly been a cooperative effort by the environmental education community; we wish to express our appreciation to all.

August F. Scornaienchi

HISTORICAL DEVELOPMENT

The modern environmental movement which began in the late 1960's has brought about major changes in the ways in which Americans relate to the land, its resources, and to each other. In the early 1970's, the term environmental education came into use as a means of describing an appropriate educational response to this new ethic.

In 1973, the California State Department of Education published a book entitled **Ekistics — A Guide for the Development of an Interdisciplinary Environmental Education Curriculum.** The publication was based on the work of Paul Brandwein, and specified learning experiences in three broad areas in which humans interact with the natural world: in the exchange of matter and energy, through social institutions, and through cultural components and forms. The publication is still in print and considered valuable by many.

In late 1978, a group of representatives of state resource management agencies and the education community got together to discuss environmental education in terms of what had been learned over the years since the development of **Ekistics**, through license plate grants, federal projects, resource agency programs, and other activities. As a result of this meeting, a new set of goals and objectives were developed, and these, in turn, were written into the 1979-81 county superintendents cooperative **Course of Study**.

In that publication, it was observed that environmental education had instructional implications in a number of discipline areas, and specific examples were pointed out in the various subject matter sections.

The resource agency-eduction committee, which had developed the new set of goals and objectives, felt that further work was needed to produce curriculum and supporting materials which would facilitate the infusion of environmental education into the entire K-12 instructional program. A recommendation to this effect was made to the Secretary for Resources who budgeted $150,000 from fiscal 1979-80 environmental license plate funds for this purpose.

After approval by the legislature, the Department of Education called a meeting of key educators including classroom teachers, administrators, teacher educators, resource management agency personnel, and others who reviewed currently available materials, developed a content outline, and otherwise spelled out in some detail what was needed, and how the final product should be organized. It was agreed that input from both educators and resource management personnel was important through every step of the developmental process, and that the emphasis should be on practicality and usability at all levels.

The Department of Education developed a contract based on the recommendations of this ad hoc advisory commitee, and the Alameda County Superintendent of Schools was the successful bidder.

This proved to be a fortunate choice for a number of reasons. The office had a competent staff of people to do the job, was in close contact with the Bay Area education community, and most important, had the contract to produce the 1981-84 **Course of Study**. This latter circumstance proved to be most fortunate because it enabled staff to develop the environmental education material in tandem with the **Course of Study**, with the result that what was produced became a component of an extension of this key state-level publication.

The guide is based on two major premises:

- Environmental education can serve as an instructional umbrella with a great number of topic areas such as energy and conservation, marine education, outdoor school programs, wildlife resources, soil conservation, historical and recreational resource management, city planning, population growth, nature study, and others, may be addressed in a holistic manner.

- That environmental knowledge, skills, and attitudes cut across all subject matter lines at all instructional levels, and, therefore, environmental education should be seen not as a specific and separate subject, but as a theme which should be infused throughout the instructional program at all levels.

In response to the wishes of the ad hoc advisory committee, the Guide has something of practical value for everyone. For curriculum developers and producers of materials, there is a K-12 curriculum outline. Classroom teachers will find nearly 200 sure-fire learning activities selected for their suitability by their colleagues, and access to hundreds more. Administrators will find a plan for getting an appropriate program underway in their schools, resource management agency people will be able to acquaint educators with information regarding their role in resource management, management problems and issues, and materials and services they can provide.

Although publication of this material represents an important milestone in environmental education in California, we must not fall into the trap of believing that the job is completed with its printing and distribution. What happens next in schools and classrooms throughout the state will be the real measure of success for this work, and we are looking to you for your help.

Rudolph J. H. Schafer, Director
Environmental Energy Education
California State Department of Education

INTRODUCTION

A Point of View

The primary goal of environmental education is to develop citizens who are knowledgeable about the environment and involved in working toward a more liveable future. This goal is based on the following assumptions:

- The environment is not only biophysical; it is also aesthetic, economic, social, and political as well.
- Environmental education must promote an environmental ethic where people are not exploiters of the environment but are stewards concerned with the perservation of all life systems.
- Environmental education must reflect a commitment to future generations, not merely perpetuate the values of the past.
- Environmental education is not a subject, but a synthesis of concepts and skills from all disciplines that relate to the environment.
- "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends to do otherwise." (Aldo Leopold)

Organization of the Environmental Education Guide

The purpose of this Guide is to provide teachers with background information, program structure, and activities for environmental education. The Guide actually consists of four volumes: K-3, 4-6, 7-9, and 10-12. Each volume is organized around four major content areas of concern:

1. Natural Environment
2. Built Environment
3. Social Institutions and Decision Making
4. Energy and Environmental Resource Management

These areas are addressed in the following ways:

Issues related to each area of concern are examined in an effort to provide educators with background information. While by no means definitive, these statements are starting points for understanding these complex issues.

A chart, **Matching Objectives to Classroom Activities**, states the instructional objectives under each area of concern and describes, in summary, related activities at the four levels (K-3, 4-6, 7-9, 10-12).

Classroom activities are samples of ways in which a teacher can address the instructional objectives. The activities integrate key stages of cognitive development. Instructional techniques are suggested that promote problem-solving skills, values, and attitudes consistent with our role as stewards of planet earth.

Guidelines for **Planning an Environmental Education Program** are for a principal or curriculum coordinator to follow as s/he helps a group of teachers plan their program.

The appendices give an overview of the California resource agencies. This clarifies the unique role of each agency and how the agencies fit together in a joint effort to manage our state's resources. A list of no-cost and low-cost teaching materials available from these resources is included in this section as well as a directory of California resident outdoor education programs.

PLANNING AN ENVIRONMENTAL EDUCATION PROGRAM

An Interdisciplinary Approach to Environmental Education

The purpose of the **Environmental Education Guide** is to help teachers promote better understanding of the diversities and interdependencies of life systems and nurture the skills involved in decision making. This requires a synthesis of concepts and skills that relate to the environment from **all** subject areas. Environmental education is not treated as a separate, discrete discipline, but as an integration of disciplines that results in new ways of thinking about and behaving toward our environment. We, as educators, are, therefore, faced with the challenge of looking at our curriculum in perhaps a new way — one which allows us to consider the entire curriculum as a system for organizing an environmental education program.

As we integrate concepts from environmental education into the curriculum, we face the danger of fostering a nonsequential, "shotgun" approach to program planning. We hope the Planning Chapter will help guide that process in a way that encourages an individual teacher of a staff to choose concepts, objectives, and activities that are related and built upon each other in a comprehensive sequence.

Overview of Environmental Education Planning

This section of the **Environmental Education Guide** is intended to provide schools with a set of procedures for developing an interdisciplinary environmental education program. These procedures are written primarily for the individual(s) responsible for assisting schools in developing an environmental education program. This may be the principal, a curriculum coordinator, resource specialist, or a teacher. The procedures guide a school staff as they:

- Reach agreement on a working definition of environmental education.
- Review their curriculum for the purpose of identifying current environmental education classroom or school activities.
- Identify the curriculum area(s) most appropriate for infusing environmental education activities.
- Identify the curriculum area(s) most appropriate for infusing environmental education activities.

- Adopt environmental education concepts to infuse into the selected curriculum areas.
- Select and implement environmental education classroom activities.
- Assess the effectiveness of their environmental education program.

These procedures may be followed by an entire staff, or by teachers from a selected department, grade level, or grade cluster (K-3, 4-6, 7-9, 10-12). The entire process can be carried out in approximately three 1½-hour sessions.

Finally, these recommended procedures are not conclusive statements on environmental education curriculum planning. They are intended as **suggestions** and have been successful guidelines for planning other curriculum areas. Also, these procedures are **starting points** for developing an interdisciplinary program; they by no means stand alone as a definitive method toward interdisciplinarity. As these procedures are tried out and revised, it is hoped a useful method will evolve.

Reaching Agreement on Environmental Education Point of View

Session I:	The staff agrees upon a working definition of environmental education, identifies environmental education activities they currently use, and selects major areas of concern to infuse into the curriculum.

The following procedures are designed to help a school faculty come up with a common working definition of environmental education:

- The group leader begins the first session by describing the purpose and the agenda of the session.
- The leader then distributes a copy of the Point-of-View statement from page 6 of the Guide. This statement serves as a starting

point for discussion, "How do we define environmental education?"
- The leader elicits reactions and modifications from the group as they examine the Point-of-View statement. If only minor changes are suggested, participants can note changes on their copies; if extensive changes are suggested, the group leader may want to record on the chalkboard or newsprint.
- The group then attempts to reach agreement on a common Point-of-View statement which reflects their modifications. The leader may facilitate agreement by using a consensus or straw-vote process. (See the Process Glossary for explanations.)

Now that the group has a working definition of environmental education, they are ready to identify elements of environmental education in their existing curriculum.

- The group leader asks each individual to jot down those learning activities that s/he has done, is doing, or plans to do with students that relate to environmental education. These should be noted as briefly as possible, perhaps by title or a short, descriptive phrase.
- As the participants note activities, the group leader places four pieces of newsprint on the wall. Each piece is titled with one of the areas of concern from the Guide: Natural Environment, Built Environment, Social Institutions and Decision Making, and Resource Management.
- After approximately five minutes, the leader asks the group to stop writing and distributes Issues statements of each area of concern (see Guide, pages 19, 37, 53, and 71). These statements will help guide the group as they categorize their activities.
- The leader asks individuals to call out their activities and identify the area of concern that each activity best fits. The leader records responses on the appropriate pieces of newsprint.

The group has compiled a record of ways in which it already teaches about the four areas of concern, as they consider ways to further emphasize environmental education in their curriculum.

- The leader facilitates a discussion of the four areas of concern referring to the Issues statements, as well as the activities listed under each heading.
- The leader distributes Summary of Activities sheets (see pages 21, 39, 57, and 73) and assists the group as they examine the concepts, the objectives. and the activity descriptions under each area of concern.
- After discussion and clarification, the leader asks the group to reconsider its curriculum and determine which of the areas of concern it would like to emphasize in the future. Some members of the group may wish to strengthen or expand on an idea already emphasized; others may wish to tackle a new idea. The leader encourages debate (see debate in the Process Glossary).
- The leader helps the group agree upon which areas it will infuse into the curriculum. This is to be a group decision — the leader may want to use a consensus or rank ordering process to assist the group (see consensus or rank order in the Process Glossary).

The group has now agreed upon a common Point-of-View statement to use as a working definition of environmental education. It has identified currently used curriculum activities, and has also identified the areas of concern it will address in the curriculum.

Selecting Concepts for Your Curriculum

> Session II: The group modifies and selects the concepts under each area of concern that will be infused into the curriculum. Each participant agrees to teach two or three concepts and report back to the group.

The following procedure guides the group as they modify concepts for each selected area of concern:

- The leader describes the purpose and agenda of the session.
- The group forms teams of four to six members. Each team meets around a table (see working in groups of four to six in Process Glossary). Each member has a copy of the Summary of Activities sheet for each of the areas of concern to be infused into the curriculum.

- The leader asks all teams to review concepts, objectives, and activity descriptions for all selected area(s). The leader moves from group to group so that participants have the opportunity to ask questions of clarification.
- The leader then assists the teams as they consider modifications and/or additions.
- After approximately 15 minutes, the leader calls the group back together and elicits proposed changes. These suggestions are recorded on the chalkboard or recorded on newsprint; the leader then helps the group agree on final modifications and/or additions, if any (see consensus or rank order in Process Glossary).

The group now has a satisfactory set of concepts and will select specific concepts to emphasize in their curriculum. They may choose one or several concepts listed under each selected area.

- The group discusses which concepts are most appropriate for its curriculum. They may consider the ages and interests of their students, time constraints they foresee, their own interests and abilities, and the availability of related resources.
- Participants are encouraged to advocate for specific concepts they may think should be included in the curriculum (see advocacy in the Process Glossary).
- After the discussion and advocacy period is over, the leader helps the group reach agreement on which concepts they will include in their curriculum. Once again, the consensus or rank order process may be useful (see Process Glossary).
- This process is repeated for each area of concern the staff has selected.

The group now has a clear picture of the area of concern and related concepts it will infuse into the curriculum. It is now ready to make personal commitments to implement related concepts.

- The group leader prepares the following matrix on the chalkboard or newsprint:

MATRIX I: CHART FOR ELEMENTARY

Teachers' Names and Grade Level	Sam K	Joan 1	Betty 1	Lloyd 2
Selected area of concern and concept				
Natural A	Music	Science	Language Arts	Science
Natural C	Art			Math
Built B	P.E.	Art	Social Sciences	

MATRIX II: CHART FOR SECONDARY

Teacher's Name	Mary	Sam	Tony	Alice
Selected area of concern and concept				
Natural A	U.S. History	World History	Amer. Govt.	Calif. History
Natural C	Calif. History			Calif. History
Built B			Geog.	Calif. History

- Participants have a copy of selected area of concern and concepts. The leader asks participants to identify into which subject area(s) each concept will be infused.
- As participants call out their choices, the leader records the subject area in the appropriate box, or, if by department, the unit or subtopic (see Matrix II).

- When all participants have committed themselves, the leader asks the group to consider the entire matrix. Does the matrix reflect a balanced curriculum, or does it emphasize some subject area and not others? The group may adjust its choices to create a more balanced curriculum.
- Participants then agree to try out one or more activities for the concepts they have each selected and to report back to the group in four to six weeks.
- Optional. Participants gather activities that will teach toward their selected concepts. They use activities from the Guide (pages 21, 39, 57, and 73), suggested activities from Session I, or ideas generated in small groups. The group has modified and selected concepts to infuse into its curriculum. Each participant has then selected concepts to try out with his/her students over a four to six week period.

Assessing Progress

> Session III: The group reconvenes to assess progress toward infusing environmental education into the curriculum.

- The group leader describes the purpose and agenda for the session.
- The group divides into teams of four to six; each team meets around a table with two pieces of newsprint.
- Team members identify and record what is going well and why as they try out activities for the selected concepts. The leader moves from group to group, observing and assisting when necessary. Papers are posted.
- Team members then identify and record problems they are having as they try out activities. They list reasons for those problems and post papers.
- The teams are now ready to determine the next step(s) toward infusing environmental education into the curriculum. Given the things that are going well, the problems and the reason for each, what are some next steps? Possibilities may be:

  To continue with current program, with little or no adjustments.
  To gather more activity ideas, based on those that have been successful.
  To focus on solving one or more problems that seem to be major hindrances.
  To try activities from the Guide.
  To gather other resources listed in the Guide (see page 83).
  To schedule an in-service in environmental education.

- The group leader assists the participants as they decide on what specific action to take. S/he helps them outline necessary steps toward that action and divide up responsibilities so that necessary action is taken.
- Dates are set for getting together to review progress. The group has reviewed and assessed its progress toward infusing environmental education into the curriculum; it has also identified any necessary future actions. The procedure outline in Session III can be an ongoing process.

AN INDIVIDUAL APPROACH

The following procedure is designed for an individual teacher who plans to infuse environmental education into his/her curriculum.

1. Refer to the environmental education curriculum matrix on page 13 of the Guide. This matrix will help you select the appropriate subject area(s) and related concepts for teaching environmental education in your classroom.

2. Subject areas are listed across the top of the matrix.

COURSE OF STUDY GOALS AND OBJECTIVES

ART	BUSINESS EDUCATION	CONSUMER/ HOME EC.	DRAMA/ THEATRE	ENGLISH LANG. ARTS/ READING	FOREIGN LANGUAGE	HEALTH	INDUSTRIAL ED.	MATH	MUSIC	PHYSICAL EDUCATION	SCIENCE	SOCIAL SCIENCE

Choose the subject area(s) into which you will infuse environmental education.

3. Under each subject area you will find numbers which refer to objectives in the **Course of Study**. Locate each numbered objective for the selected subject area(s) by referring to page 15. Read the selected objective. If they are appropriate for your students, refer back to the matrix.

4. You will note that the **Course of Study** objectives are matched to environmental education concepts, which are listed down the left side of the matrix.

NATURAL ENVIRONMENT	A. The natural environment functions according to patterns of established relationships between living and nonliving things.
	B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.
	C. The sun is the ultimate source of energy which all life on earth needs in order to exist.
	D. The environment is being shaped continually by naturally & humanly produced forces which can alter the balance of conditions & lead to changes in the plants & animals which are able to exist there.

Read those environmental education concepts that correlate with the numbered **Course of Study** objectives noted above. If these environmental education concepts are appropriate for your students, you are ready to select objectives and activities for your curriculum.

5. Environmental objectives are listed under the four major areas on the following pages:

Natural Environment, page 20

Built Environment, page 38

Social Institutions and Decision Making, page 56

Energy and Environmental Resource Management, page 72

Refer to the appropriate pages, locate the selected concept(s). Choose one or more objectives under each selected concept.

Review activities which are matched to those objectives. Select activities to try with students (or gather activities from other sources).

After trying out activities, identify what went well and what were some of the problems. Modify your program accordingly.

If you wish to infuse environmental education into other subject areas, repeat these procedures.

ENVIRONMENTAL EDUCATION CONCEPTS

COURSE OF STUDY GOALS AND OBJECTIVES

		ART	BUSINESS EDUCATION	CONSUMER/ HOME EC.	DRAMA/ THEATRE	ENGLISH LANG. ARTS/ READING	FOREIGN LANGUAGE	HEALTH	INDUSTRIAL ED.	MATH	MUSIC	PHYSICAL EDUCATION	SCIENCE	SOCIAL SCIENCE
NATURAL ENVIRONMENT	A. The natural environment functions according to patterns of established relationships between living and nonliving things.												1.2 1.3	
	B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.													
	C. The sun is the ultimate source of energy which all life on earth needs in order to exist.													
	D. The environment is being shaped continually by naturally & humanly produced forces which can alter the balance of conditions & lead to changes in the plants & animals which are able to exist there.	1.1						3.1		3.4		5.3	4.3	1.2
BUILT ENVIRONMENT	A. Built environments depend on resources from the natural environment for survival.			3.1										
	B. The design and maintenance of built environments have both reflected and influenced the values, ethics, and lifestyles of the inhabitants.			3.2 1.1 1.2			3.2		4.3			5.4		4.3
	C. Built and natural environments function in similar ways and share many basic needs for survival and growth.							1.4						
SOCIAL INSTITUTIONS AND DECISION MAKING	A. Environmental problems transcend political entities, state and national boundaries & cultural differences.						3.1							4.1
	B. The goals for every society include economic prosperity which is based, in part, on natural resources.		4.4											
	C. Individuals & private groups within our society & independent of the major social, economic, & political decision-making institutions play an important role in developing public awareness of environmental issues & in monitoring public and private activities in relation to the environment.	4.4		3.3	1.2 4.2	6.2		3.3						3.1
	D. Educational institutions & communications media are potential sources for the creation of public awareness of environmental issues.							2.3			4.3			
	E. Environmental law is intended to regulate use of the environment for present & future generations.							2.1 3.2						
RESOURCE MANAGEMENT	A. There are a number of historic & present day models which can be used in developing management programs.													
	B. Conservation is the most immediate way of increasing the real supplies of a natural resource. Conservation practices focus on more efficient uses of natural resources.													
	C. Some resources are renewable & can be maintained so they will provide consistent & continuous supplies of resources as they are needed.								4.2					
	D. To understand the role of the resource agency & its departments in maintaining the productivity of our natural resources into the future.													

PROCESS GLOSSARY

Advocacy is a process that can be used with a group to help discuss the pros and cons of a series of options. The rules are:

- Individuals have 30 seconds to lobby for or against the importance of an option.
- An individual may have additional 30-second periods as long as each period is preceded by someone else's 30 seconds.

Advocacy provides a group with a structure to assist individuals to hear each other. The leader explains the rules, suggesting that individuals name the item they are promoting or not promoting. S/he assists individuals to advocate and monitor the time.

Consensus

Consensus is a process that can be used with a group to reach maximum agreement among its members. Agreement is usually made by a group among a number of options. The leader assisting a group to reach consensus makes sure that everyone understands the options being considered. S/he asks for suggestions as to which options the group wants to take on. These options are noted. S/he points out each option asking the question, "Is there anyone who can't live with the group selecting this option?" If no one objects, the group has reached consensus. If some members object, the leader moves to a next option. This continues until one or two options have only one or two objectors. The leader can ask the one or two what needs to be done to enable them to live with the option. The leader checks out the change with the group.

Curriculum Rating Process

This process may be used to select the curriculum areas in which to infuse environmental education. Individuals are asked to rate the potential for infusion for each of the identified curriculum areas according to this scale.

3-Excellent Potential 2-It's Possible 1-Very Improbable, Forget It

Individuals record their ratings on a chart.

	Person #1	Person #2	Person #3	Person #4
LANGUAGE ARTS	1	1	1	1
SCIENCE	3	3	2	1
SOCIAL SCIENCE	2	3	3	2

Scores are totaled; areas receiving high scores are the better candidates for infusion.

Rank Order

Rank order is a process that takes individual orderings of a set of items and accumulates the ranking to obtain a group ordering. The items to be ordered are labeled by a letter — A, B, C, etc. Each individual is given small 3" x 5" sheets of paper. Each paper is labeled A, B, C, etc. Each person is directed to order his or her papers according to importance. S/he is then asked to number the papers 1, 2, 3, etc.; 1 is the most important.

All the A's, B's, C's, etc., are collected. The numbers on each of the A's are added, then the B's, then the C's, etc. The letter of the option receiving the lowest total number is the most important.

Working in Groups of Four to Six Persons

Rather than work with staff in large group discussion, it may be helpful for groups to work in smaller groups in discussion and decision making. The leader can ask the subgroups to work on tasks of reviewing information, developing options, and forming decisions. Then s/he can collect items from each group and record them on the chalkboard or butcher paper. This helps the group review its comments and reach a decision.

COURSE OF STUDY OBJECTIVES THAT RELATE TO ENVIRONMENTAL CONCEPTS

ART

1.1 To develop awareness of color, shapes, and textures in human-made and natural environments.
4.4 To demonstrate skill in using creative expression as a means of bringing about constructive action to solve social and environmental problems.

BUSINESS EDUCATION

4.4 To develop an understanding of business economics.

CONSUMER/HOME ECONOMICS

1.1 To develop an awareness of personal values in relation to different lifestyles.
1.2 To develop an awareness of personal resources in relation to different lifestyles.
3.1 To develop an understanding about the relationship of housing choices to aesthetic, social, and environmental issues.
3.2 To understand how personal lifestyle choices affect the quality of the environment.
3.3 To understand how community, state, and federal resources are used to provide services within a community.

DRAMA/THEATER

1.2 To develop problem-solving skills through creative drama and improvisation.
4.2 To become aware of the role of drama/theater in influencing public opinion in areas of merchandising, human relations, and politics.

ENGLISH LANGUAGE ARTS/READING

6.2 To develop skills for making critical analyses of written materials and media presentations.

FOREIGN LANGUAGE

3.1 To understand the attitudes and values, customs, traditions, and taboos which make up the culture.
3.2 To become familiar with the environments in which cultural groups have developed.

HEALTH

1.4 To develop strategies for daily living that build self-acceptance and reduce stress and anxiety.
2.1 To understand the causal factors of diseases or other physical disorders and develop strategies for preventing, treating, or controlling these malfunctions.
2.3 To develop skills for evaluating health information, products, and services.
3.1 To understand the relationship between ecological balance in the environment and people's mental, social, and physical well-being.
3.2 To understand the types of resources needed to protect the health of people in local, state, national, and world communities.
3.3 To develop awareness of the personal and community resources that can be used in accident prevention and in meeting emergency situations.

INDUSTRIAL ART

4.2 To develop an awareness of the basic economic structure of our industrial society.
4.3 To develop an awareness of the relationship between environment and industry.

MATHEMATICS

3.4 To develop skills for recognizing and using geometric figures in the environment.

MUSIC

4.3 To understand how cultures and historical periods influence musical styles and forms.

PHYSICAL EDUCATION

5.3 To understand the impact of various recreational activities on the environment.
5.4 To value leisure as a complementary balance to work.

SCIENCE

1.2 To be aware of order and beauty in the natural environment.
1.3 To appreciate and respect all living organisms (including self) and their place in the environment.
4.3 To demonstrate an understanding of the ways in which science and technology affect individual lifestyles and social/cultural development.

SOCIAL SCIENCE

1.2 To understand how societies develop in diverse physical and social settings and meet the needs and desires of their members.
3.1 To understand differences and similarities of the value systems held by different cultural and social groups in the American society.
4.1 To develop an awareness of social change in the past and present and to anticipate future change.
4.3 To participate in social action projects that are of benefit to the community.

Classroom Activities

Natural Environment

The classroom activities in this section are samples of ways in which teachers can address the instructional objectives. These activities help students to understand the connections between the biological and physical worlds, the unique characteristics of habitats, the fundamental importance of the sun, and the effects that the ecosphere has on natural and human forces.

Built Environment

The classroom activities in this section assist students in understanding the dependency of the Built Environment on the Natural Environment, the evolution of the Built Environment and its influence on societal values and stresses, and that the Built and Natural environments are intertwined through an intimate cause/effect relationship.

Social Institutions and Decision Making

The classroom activities in this section are samples of ways in which teachers can assist students to understand that environmental problems transcend political entities, state and natural boundaries, and cultural differences, and that individuals, institutions, and private groups within our society play an important role in developing public awareness of environmental issues.

Energy and Environmental Resource Management

The classroom activities in this section are samples of ways in which students can understand the importance of conservation, the costs and benefits of continuously renewing resources, and how we manage our resources in the state.

Natural Environment Activities

NATURAL ENVIRONMENT

Issues

The part of the Natural Environment of planet earth where all known life systems exist is a relatively thin belt of water, land, and atmosphere called the ecosphere. The ecosphere is comprised of separate, yet interrelated communities of living things called ecosystems, each with its unique mosaic of plants, animals, bacteria, and viruses. The physical and chemical environment of each community determines what can survive there; this intricate web of relationships between the biological and the physical world is fragile and continually changing.

Chemical elements, such as carbon, hydrogen, oxygen, and nitrogen, are essential nutrients for all life forms. They circulate through life systems, continually replenishing the environment and regulating the abundance of life.

Water is a principal means of transport for nutrients traveling throughout the environment. Run-off water from precipitation carries suspended and dissolved elements from the land to the oceans. Radiant energy from the sun lifts them, through evaporation, to be dispersed by wind action. This is the hydrologic cycle, the major transport system for circulating ingredients throughout the ecosphere.

An alteration in the physical or chemical composition of a natural community results in concomitant alterations in the biological compositon. Usually, these changes are gradual — a lake may slowly fill in to become a marshland, then a bog, and climax as a meadow.

Sometimes, however, the process of change may be more sudden and, hence, immediately destructive. A volcanic eruption is an example of a sudden destructive change caused by natural forces. Filling in coastal wetlands for land development is less violent but is an equally destructive change caused by human forces. Agriculture is another human force that affects a natural community, this time by preventing the natural evolution of the land from taking place. Because the tendency to diversify is held in check, agricultural lands become susceptible to disease-carrying bacteria and the invasion of pests. This condition is compounded as crop strains are further refined and farmers plant increasingly specialized monocultures.

Landfill and agricultural practices are two ways that human activity directly affects the ecosphere. Other ways are more insidious, such as industrial pollution, which enters the hydrologic cycle and results in acid rain. It is becoming increasingly apparent that humans must consider the long-range effects of their actions upon the ecosphere before the fragile web of life systems is irrevocably harmed.

Four concepts have been identified to help students understand life systems. The first is concerned with the interconnectedness between the biological and the physical worlds. The second considers the importance of habitats and their unique characteristics. The third stresses the fundamental importance of the sun. The fourth examines natural and human forces which affect the ecosphere.

NATURAL ENVIRONMENT

MAJOR CONCEPTS	OBJECTIVES
A. The natural environment functions according to patterns of established relationships between living and nonliving elements.	1. To understand that all living things play roles and have functions in relation to maintaining and renewing the natural environment. 2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings. 3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.
B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.	1. To understand that different species of plants and animals depend on specific types of habitats for survival. 2. To understand that each system — water, land, air — contains resources that are important for the maintenance of life.
C. The sun is the ultimate source of energy which all life on earth needs to exist.	1. To understand how the energy radiated by the sun is used on earth to maintain ecological processes. 2. To understand that energy can be stored by plants and converted through natural processes into large scale energy sources, such as petroleum, natural gas, and coal. 3. To understand that energy can neither be created nor destroyed. It is in a constant state of flux.
D. The environment is being shaped continually by natural and human forces which alter the balance of conditions and lead to changes in plant and animal populations.	1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area. 2. To understand how the biological community of plants, animals, and microorganisms adapt to the environment through changes in genetic composition and population size. 3. To understand how humans manipulate the environment and cause changes in the balance of conditions. 4. To understand the natural forces that continually shape the environment.

NATURAL ENVIRONMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand that all living things play roles and have fuctions in relation to maintaining and renewing the natural environment.	Students take a mini-safari to find out what lives in and around a variety of microhabitats.	Students build a model food pyramid with their bodies.	Students take a census of an outdoor site "job descriptions" for the organisms observed.	Through guided imagery, art, and language arts, students assess the results of the removal of one element from an ecosystem.
	2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings.	Class sets up a mini-ecosystem in an aquarium.	Students sit in a circle and pass a ball of yarn to form a "web of life."	Students calculate the amount of H_2O released from a leaf through transpiration.	Student committees present mixed media shows illustrating the ecosystem of a nearby area.
	3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.	Students compost their food waste.	Students' lunches are recycled in the classroom by common decomposers.	The decomposing role of sowbugs in the forest ecosystem is studied.	Students collect and arrange specimens in a terrarium.
CONCEPT B	1. To understand that different species of plants and animals depend on specific types of habitats for survival.	Students experiment to determine how plants will grow when subjected to different "types" of water.	Students play a cooperation game modeling systems interaction.	Students take a census of two adjacent natural communities and the ecotone between them.	Students make a mural of the water cycle. They interject disruptions in the environment.
	2. To understand that each system - water, land, air - contains resources that are important for the maintenance of life.	Students hang Vaseline coated paper to collect particles in the air.	Students model a resource balanced ecosystem in a game format.	Students do a worksheet activity on the marine food chain.	Students express opinions on ocean resource issues through debate, language arts, and/or graphics.
CONCEPT C	1. To understand how the energy radiated by the sun is utilized on earth to maintain ecological processes.	Students sprout beans in a sunny area and a dark area to compare beans from each area.	A series of experiments are conducted on the use of sunlight by plants.	Students test uncovered and foil covered coleus leaves for starch production.	Students trace a favorite food back to its ultimate source and trace the use of energy in supplying the food.
	2. To understand that energy can be stored by plants and converted through natural processes into large scale energy sources such as petroleum, natural gas, and coal.	Students are introduced to plants (foods) that give them energy.	Students simulate natural oil deposits by starting a compost pile.	Students prepare and perform a role-play activity on energy transfer.	Teacher leads the class in an extended role-play, modeling the process of fossil fuel generation.
	3. To understand that energy can neither be created nor destroyed—it is in a constant state of flux.	Students participate in a cooking activity to investigate physical and chemical changes.	Students use thermometers to measure heat in classroom.	Students read several personal statements on energy as a stimulus to expanding their own perspectives and writing their own poems.	Students examine the role the sun has played in the culture, past and present.
CONCEPT D	1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area.	Students investigate different sites in an outdoor area for heat, wind, moisture, etc.	Students experience directly the dramatic results of disruptions in an ecosystem.	Students find the locations outdoors, which are warmest, coolest, brightest, etc. (see level 1).	Through experiments and observation games, students make judgments on probability and desirability of trees in the environment.
	2. To understand how the biological community of plants, animals, and microorganisms adapt to the environment through changes in genetic composition and population size.	The group hunts for colored "worms" in two habitats and compares results.	Students role-play deer in a forest by looking for food, water, and shelter. A rock/paper/scissors game.	Students design animals or plants and explain the reasons for the organisms survival or extinction.	Students research local endangered species, analyze the problem, and prepare action statements.
	3. To understand how humans manipulate the environment and cause changes in the balance of conditions.	Students take a walk to examine the micro-habitats on and near walls.	Students simulate chemicals causing environmental changes and try to control their use and abuse.	Students set up indicators for CO and O^3 in several outside locations.	Students rate environmentally sensitive practices on a values continuum.
	4. To understand the natural forces that continually shape the environment.	A model stream table is set up. Students manipulate water flow and land forms.	Students write stories about, and act out, the natural forces which shape our environment.	Students construct a model of geological evolution — before and after demonstration.	Students assess the possible causes of global glaciation and write a disaster film script.

THE INCREDIBLE SHRINKING KID

DESCRIPTION
Students take a "mini-safari" to find what lives in and around a variety of microhabitats.

OBJECTIVE
A-1. To understand that all living things play roles and have functions in relation to maintaining and renewing the natural environment.

PURPOSE
To investigate the living and nonliving components of a habitat.

Time	Where
½ hour	Any outdoor area
Topics	**Materials**
Ecology, ecosystem, interdependence	For each student: hand lens, egg carton (or other container), yarn or string, approximately three meters long for each *pair* of students

LEAD-UP/PREPARATION
Select an outdoor study site that has a variety of habitats (perhaps a grassy area next to pavement). Determine the boundaries.

ACTIVITY
Step 1
Students pretend they have magical magnifying lenses that shrink them to the size of an ant. In other words, through the lenses they see the world as an ant would. They are going on a mini-safari to explore an unknown trail. Divide the group into pairs; give each pair a piece of yarn to make the trail. Pass out the hand lenses and the egg cartons. Encourage the pairs to spread out to different areas within the boundaries. Ask each pair to bring back samples of what they find in their area to share with the rest of the group.

Step 2
Allow approximately 15 minutes for exploration. Circulate among the pairs asking:
Q: Who lives near your trail?
Q: What was moving when you found it?
Q: What was not moving?
Q: What were the animals doing when you first spotted them?
Encourage only enough collecting to represent what was found along the trail.

Step 3
Bring the group together into a circle with pairs from similar habitats sitting near each other. Begin with sharing what each pair found. Focus on specific attributes of the items they collected.
Q: Are there any objects that have been collected by many teams?
Q: Are there any objects that have been collected by only a few teams?
"Put all the *rough* objects together; the *smooth* objects together."
Q: What other groups can be made by feeling the objects?
"Mix up all the objects. Now put all the *green* objects together; the *brown* objects together."
Q: What other groups can be made by looking at color?
"Mix up all the objects again. Put all the objects that are *alive* together; all that are *not alive* together. Now use just your alive group of objects."
"Put all objects that are *alike* together."
Q: How are they alike?
After each classification question, compare the objects from one habitat to the objects from another. (Example: "How are the living things from the grassy area different from the living things from the pavement?") Encourage the group to put the objects back where they found them.

FOLLOW-UP
Crayon rubbings or sunprints are good methods for recording what they found.

EASY ECOSYSTEM

DESCRIPTION
Class sets up a mini-ecosystem in an aquarium.

OBJECTIVE
A-2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings.

PURPOSE
To observe and record changes and interactions within an ecosystem.

Time
Activity: 45 minutes
Total time: 2-3 weeks

Where
Any outdoor habitat and classroom

Topics
Ecosystem, food chains, interdependence, cycles/life cycles

Materials
Aquatic tank or ant farm container, trowels, collecting containers—one per student, lenses, bug boxes or transparent containers, mirror, microscope, white paper (or fabric), black paper (or fabric)

LEAD-UP/PREPARATION
Set up a simulated ecosystem in the classroom by having students collect representative objects (living and nonliving) from a selected habitat. Using the aquatic tank, put in a six inch layer (15 cm) of soil and plants (or water, if from an aquatic habitat); add animals and a little water.

ACTIVITY
Keep these tools near the tank: hand lenses, bug boxes, mirrors, microscope, piece of white paper and a piece of black paper. The paper can be used as background for making organisms show up. Have the students record changes that they observe.

EXAMPLE:

ANIMAL MOVEMENT		
Time	Animal	Where it was found in tank
Before school		
At lunch time		
After school		

FOOD CHAINS		
Animal	Eats	Is eaten by

Watch for
- Anything that dies
- Any new life
- Any new smells

Examine
- A plant (or plant part)
  Is it being eaten? How can you tell?
- An animal
  Watch it for five minutes. How does it spend its time?
  Put it in a bug box. What shape is it? Turn the box. Does the animal appear to be the same shape? Try to draw the animal.

FOLLOW-UP
1. Examine a rotting log, preferably in its habitat. Observe and discuss evidence of life, decay, food webs, etc. Compare to simulated ecosystem.
2. Write a "Recipe for Our Ecosystem." What ingredients did it require? Write recipes for other ecosystems (forest, desert, etc.). Does every animal have food? a shelter? enemies? What would the soil be like? What would the weather be like?

LOVE YOUR LEFTOVERS

DESCRIPTION
Students compost their food waste.

OBJECTIVE
A-3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.

PURPOSE
To observe the process of recycling between living organisms and their surrounding environment.

Time	Where
2-4 weeks	Classroom and outside
Topics	**Materials**
Energy, gardening, renewable resources, solid waste, recycling	A five gallon deli plastic can or a ten gallon plastic can with lid, mat knife, two blocks of wood about one ft. (30 cm) long, an old broom handle or a sturdy long stick, worms, sowbugs, and other creatures that live in soil, a round-end knife, sawdust, lunch leftovers, self-adhesive stars

LEAD-UP/PREPARATION
Cut holes in the plastic can, using the mat knife. Have students bring in their leftovers from lunch. Choose one leftover and discuss.
Q: Where did it come from?
Q: Did it ever grow in the ground?
Collect worms, sowbugs, etc.

ACTIVITY

Step 1
Take all materials outdoors. Discuss composting as a way to turn our leftovers into rich soil that can nourish new food.

Step 2
Have students cut up their leftovers into very tiny pieces. Put the pieces into the plastic can and sprinkle with a layer of sawdust. Add a little water if the mixture is very dry. Add worms, sowbugs, etc.

Step 3
Put the lid on the can. Bring it back into the classroom and store in an out-of-the-way place.

Step 4
Week #1: Every morning, put the compost can outside on the blocks. After lunch, add new leftovers. Stir the compost with a stick. If it's too dry, add a little water. If it's too wet, add sawdust. Bring the compost can inside.
Week #2 and #3: Take the compost can outside. Don't add more leftovers. (They can be saved in a can with sawdust.) Look at the compost carefully.
Q: Can you find your leftovers?
Q: What didn't decay?
The compost is ready when it looks like soil. (Also, the temperature will drop.) This takes 2-4 weeks.

FOLLOW-UP
Have students save one wrapper from their lunches (a bag, banana peel, can, etc.). "Let's see if we can put these wrappers to work instead of throwing them away. Put a sticky star on your wrapper every time you use it. Let's see which wrappers last the longest."

Graph results:	wrapper	times used
	jar	• • •
	foil	• • • •
	peel	• •

Adapted from *Spaceship School*

WATER YOU DRINKIN'

DESCRIPTION
Students experiment to determine how a plant will grow when subject to different "types" of water.

OBJECTIVE
B-1. To understand that different species of plants and animals depend on specific types of habitats for survival.

PURPOSE
To learn that living things are affected by variations in the components of the ecosystem.

Time	Where
Several class periods over 2-3 weeks	Classroom
Topics	**Materials**
Adaptation, diversity, plants, water/water quality	Plants, liquid measuring cups, different "types" of water, solutions (salt, soap, plain, etc.)

LEAD-UP/PREPARATION
Brainstorming with students, list as many different types of water that could be used in an experiment for watering plants (e.g., tap water, salt water, rain water, soapy water, pond water, etc). Decide on at least four different types of water to use.

ACTIVITY

Step 1
You will need at least two plants for each type of water to be used; all plants of same species and all other growing conditions should be alike. The only variable will be the type of water used for watering the plants. Have students group plants according to type of water to be used and label the groups accordingly. Plants should be watered regularly with equal amounts of water for two–three weeks at same time of day.

Step 2
Students observe plants and record observations daily. This can be done with pictures, writing, or orally.

Step 3
Conclusion: Help students to draw conclusions about effects of different types of water on plants. Encourage them to hypothesize as to the reasons for differences.

FOLLOW-UP
Ask if they think that plants growing in different parts of the earth get different kinds or amounts of water. Do plants in the desert get the same amount as plants in the mountains? How do you know? Do plants in different places grow in different kinds of soil? Have students bring in different types of soil, and compare texture, smell, looks, moistness, etc. You might experiment with different types of soil in a way similar to the water experiment cited above.

WRITTEN ON THE WIND

DESCRIPTION
Students hang Vaseline-coated paper to collect particles in the air.

OBJECTIVE
B-2. To understand that each system—water, land, air—contains resources that are important for the maintenance of life.

PURPOSE
To illustrate human impact on air quality.

Time	Where
2 half-hour periods spread over one week	Classroom and outdoors near streets, buildings, in trees, etc.
Topics	**Materials**
Chemical/biological contamination, pollution-air, environmental quality	For each student: 5 cm square of waxed paper, 5 cm square of cardboard, hand lens or magnifying glass, tape, smocks and paper towels

LEAD-UP/PREPARATION
Cut a 5 cm square of cardboard and waxed paper for each student. Tape the paper to the cardboard.

ACTIVITY
Have each student:

Step 1
Label a square with his/her name. Cover the paper with an even coat of Vaseline (a messy process!). Place each square in a place where it will be undisturbed for a week. Be sure the squares are distributed among a variety of places, both inside and outside (e.g., sun, shade, in a little-used space, in a frequently used space, flat, vertical). After a week, examine each square with a hand lens or magnifying glass.

Step 2
Count the number of particles collected. Compare different particles on each square (sizes, shapes, colors). Compare the squares.

FOLLOW-UP
Attach a Vaseline smeared cloth to the tail pipe of several cars. Have the driver of each car start the motor and idle the engine for three minutes. Compare residues, noting make, model and year of each car.

Adapted from *Greenbox and Spaceship School*

BEAN SPROUTS

DESCRIPTION
Students sprout beans in a sunny area and a dark area to compare the beans from each area.

OBJECTIVE
C-1. To understand how the energy radiated by the sun is used on earth to maintain ecological processes.

PURPOSE
To explore the effect of sunlight on a plant food source.

Time	Where
Activity: 30 minutes Total time: 3-5 days	Classroom
Topics	**Materials**
Energy, food chains, gardening, plants	For each group (two to five): beans soaked overnight in water (Mung beans or lentils are good), two jars, with a wire screen instead of a lid, plastic bags, with a handful of different beans and seeds (one bag per child), pitcher of water

LEAD-UP/PREPARATION
Pass out beans, seeds, jars, and pitchers of water to each group.

ACTIVITY
Step 1
Q: Have any of you ever grown a garden?
Q: What kinds of plants did you grow?
We often plant *seeds* in our gardens and wait for the seeds to grow into plants.

Q: What do seeds need in order to grow into plants?
Today we will set up an experiment to find out if *sunlight* affects how seeds grow.

Step 2
Pass out screen-covered jars and beans for sprouting. Give each group of two to five students two sprouting jars and a handful of well-soaked beans.

Step 3
Give directions for setting up sprouting experiment: Have each student count out an equal number of beans (10-25 per child) for each jar. Allow students in each group to take turns rinsing the beans by filling each jar half full of water, and then pouring the water (through the screened lid) back into the pitcher.

Step 4
Allow each group to select a light spot and dark spot in which to leave their jars for the next three to five days. Place half of the jars in light spots; put half the jars in dark spots. Rinse the seeds daily to keep them moist.

Step 5
Encourage prediction of outcome.
Q: Will the beans in both jars look the same in three days? How might they look different?

Step 6
Distribute the sprouts among students. As they eat them, ask:
Q: How did the sprouts left in the light spots differ from sprouts left in the dark?
Q: What did light do to the sprouts?

FOLLOW-UP
Further explore the properties of sunlight by doing "Habitat Sunprints" from OBIS or by using ink or dyes on fabric (they develop in the sun and are available from Screen Process Supplies Mfg. Co., 1199 East 12th St., Oakland, CA 94606 or local yarn or fabric stores).

TROUBLE-SHOOT
Direct sunlight may dry seeds out.

ARE YOU A PLANT EATER?

DESCRIPTION
Students are introduced to plants (foods) that give them energy.

OBJECTIVE
C-2. To understand that energy can be stored by plants and converted through natural processes into large scale energy sources such as petroleum, natural gas, and coal.

PURPOSE
To introduce plants as energy storage systems.

Time	Where
½ hour	Classroom or local garden
Topics	**Materials**
Energy, food chains, plants	Fresh fruits, vegetables, nuts, and other plant foods

LEAD-UP/PREPARATION
Locate a local garden with a variety of edible plants, or bring several fresh fruits, vegetables, nuts, and other plant foods to school.

ACTIVITY

Step 1
Q: Are you a plant eater?
Q: Who ate plants for breakfast?
Q: Who brought plants for lunch?
Allow time for children to share and discuss answers.

Step 2
Allow students to smell and taste plant samples. Have them guess what part of the plant they are smelling or eating; e.g., root, stem, leaves, buds, flowers, fruit, seed, pollen.

Step 3
We eat some plants, not only because they taste good, but also because they give us *energy*. Plants store lots of the things, like vitamins, that we need to stay healthy and grow.
Q: Besides humans, can you think of other plant eaters?

FOLLOW-UP
1. Make vegetable prints to record some plants we use as food.
2. Carefully try activities from *Using Wild Edible Plants with Children* available from the UC School of Education.

Adapted from *Manure to Meadow to Milkshake*

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KITCHEN CHEMISTRY

DESCRIPTION
Students participate in a cooking activity to investigate physical and chemical changes.

OBJECTIVE
C-3. To understand that energy can neither be created nor destroyed. It is in a constant state of flux.

PURPOSE
To investigate physical and chemical changes caused by dissolving, heating, cooling, etc.

Time	Where
1-2 hours, depending on recipe chosen	Classroom or school kitchen
Topics	**Materials**
Energy, food chains	Recipe, ingredients, cooking utensils

LEAD-UP/PREPARATION
List the ingredients and the utensils on the board. Ask volunteers to bring the amounts needed for the recipe, plus a little extra for the lead-up activity. Display small amounts of each ingredient. Sort according to texture (powders, thick liquids, runny liquids), color, taste, etc. Try dissolving each in water. What happens? Chart the time it takes for each ingredient to dissolve.

Step 1
Cooking activities work best when done in small groups with *close adult supervision*. Three options for organizing are:
1. Have a parent or aide take one group out of the classroom at a time to the school kitchen or another work place.
2. Give each group work cards with simple step-by-step cooking directions. Have an adult work with each group. Carry out procedure with entire class simultaneously.
3. Set up cooking station, with adult supervision. Rotate groups to that station.

Step 2
As students mix ingredients, encourage them to notice changes in texture, color, temperature, etc. Be sure all students get a chance to stir and measure.

Step 3
As students are eating their finished product:
Q: Can you find evidence of any of the original ingredients?
Q: How did the ingredients change? Are they still present?
Q: Can we reverse the process and change all ingredients back into their original state?
Q: What caused the change?
Q: How do we know something changed? (color, taste, texture, smell)

FOLLOW-UP
Observe other simple changes—a candle burning, ice melting.
Discuss:
- What is changed?
- Can the change be reversed?

ENVIRONMENTAL EXTREMES

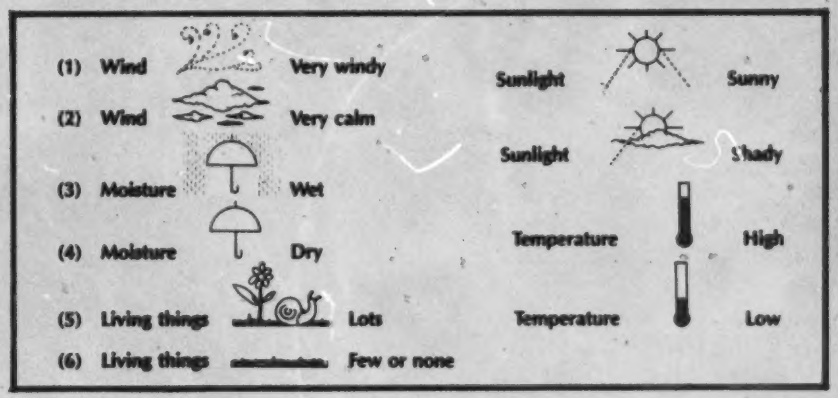
DESCRIPTION
Students investigate different sites in an outdoor area to determine which sites have the highest and lowest amount of heat, wind, moisture, sunlight, and organisms.

OBJECTIVE
D-1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area.

PURPOSE
To learn that different environmental factors affect each other (e.g., the amount of sunlight affects the amount of moisture in a given area).

Time 1 hour	**Where** Outside area with variety of conditions (shade, sunlight, wind, etc.).
Topics Carrying capacity, diversity, habitat/community, limits, weather/water quality.	**Materials** 3"×5" (7.5×12.5 cm) cards mounted on bamboo skewers or sticks (enough for each student to have a high and low card for one factor), markers for designating five or more sites in outdoor area, thermometers, pinwheels or cloth rag, paper towels, light meter or sun-sensitive paper (optional)

LEAD-UP/PREPARATION
1. Teacher prepares environmental high and low cards. Label the cards as follows:



2. Choose study area.
3. Designate and mark five specific sites within the study area, each with different environmental conditions.
4. Students practice investigating environmental variables by:
   - Arranging glasses of water from cold to hot
   - Taking temperature readings with a thermometer near windows, radiator, etc.
   - Arranging damp fabric scraps or paper towels from wet to dry
   - Using a pinwheel or cloth rag in windy and calm places
   - Going on a hunt to categorize objects as human-made or natural, living or nonliving
   - Practicing using light meter, sun-sensitive paper, or distinguishing with eyesight among shady spots
   - Marking his/her choices

ACTIVITY

Step 1
Teacher points out the boundaries of study area and the markers designating the five or more specific sites.

"We're going on a high-low hunt to find the coldest and warmest, the windiest and calmest spots, the driest and wettest spots, the most sunny and the most shady spots, and the spots with the most living things and the least living things."

Step 2
Divide class into five groups. Designate a different environmental factor for each group to investigate. Give each student (or pair of students) in the group a pair of high and low markers for his or her group's environmental factor. Distribute measuring devices to each group (one per student is optional).

Step 3
Directions to students:
- Each group should go to each of the specific sites and use its instruments to measure the temperature, wind, light, etc.
- Each student decides individually which site is the highest and lowest for his/her environmental factor.
- Each student marks his/her choices.

Step 4
When all groups have set out their markers, call the class together. Visit each site to see how many markers of each type are at the site.

FOLLOW-UP
1. Conduct activity again at a different time of day and compare results.
2. Do "Plants Around a Building" from *OBIS*.

This activity is a modified version of the OBIS activity *Terrestrial Hi-Lo Hunt* that was developed at the Lawrence Hall of Science, U.C. Berkeley

CAMOUFLAGE HUNT

DESCRIPTION
The group hunts for a variety of colored "worms" in two habitats and compares results.

OBJECTIVE
D-2. To understand how the biological community of plants, animals, and microorganisms adapt to the environment through changes in genetic composition and population size.

PURPOSE
To illustrate the importance camouflage has as an adaptive mechanism for survival.

Time 45 minutes	**Where** Two different outdoor sites, such as on lawn and on soil
Topics Adaptation, animals, diversity, population, evolution, survival	**Materials** 6 colors of pipe cleaners or toothpicks—10 of each color (cut pipe cleaners into 4 cm sections); 60 cm × 60 cm pegboard, plastic bags—one for each color

LEAD-UP/PREPARATION
Distribute colored pipe cleaners in two different outdoor areas—on ground, in trees, etc. Identify boundaries for each area.

continued

ACTIVITY

Step 1
Take the group outside. "Today we're going to pretend that we're birds who live in this area (point out boundaries). It's early morning, and we're hungry. We eat little worms that look like these (display several of the colored pipe cleaners). In our world, morning is only five minutes long, so when I say 'it's morning!' you'll want to gather as much food as possible."

Step 2
"It's morning!" Allow students to gather pipe cleaners, which you have previously distributed on the ground, for five minutes.

Step 3
Bring group members into a circle. Have them sort their pipe cleaners by color. Graph results by sticking pipe cleaners into pegboard (illustrate).

Step 4
Q: We found the most of which color? The least of which color?
Q: Why did we find more of some colors?
Q: If you were the *worm*, what color would you want to be in order to survive?

Step 5
Repeat the activity in a different site.
Q: If we repeated this activity in a forest (desert, arctic), what colors would be easy to find? Difficult to find?

FOLLOW-UP

Try these from *OBIS:* Adaptation—Predator—Prey
Invent an Animal—Adaptation
Seed Dispersal—Adaptation

WALLS AND FENCES

DESCRIPTION
Students take a walk to examine the microhabitats on and near walls.

OBJECTIVE
D-3. To understand how humans manipulate the environment and cause changes in the balance of conditions.

PURPOSE
To investigate the impact of a human modification of the environment.

Time	Where
A ½ hour period, and a 1 hour period	Schoolyard and/or neighborhood
Topics	**Materials**
Adaptation, animals, habitat/community, plants, urban environment, urban ecology	Hand lenses, bug boxes, butcher paper, crayons; other useful tools: flower press, simple bug key, simple common plant pictures

LEAD-UP/PREPARATION
Locate a safe walking route to examine a variety of walls and fences. Take the class on an introductory walk along the route.
Q: Can you find a wall or fence you can see over? Through?
Q: Do all walls and fences look the same? Feel the same?
Q: What are walls and fences for?

ACTIVITY

Step 1

"Yesterday, we took a walk to look at walls and fences. We found all kinds; some tall, some short, some we could see through, some we couldn't see through. Today we're going to look at those same walls and fences a little more closely."

Q: What are some things we might find out? Sample responses:

- What plants grow on them?
- Do the same plants grow on each side?
- What animals live in walls or around their base?
- How tall is the wall or fence?

Allow students to predict what they will find.

"In order to find out if our predictions are correct, we will take along some hand lenses, bug boxes, butcher paper, and crayons, etc."

(Distribute materials needed to answer student-generated questions.)

Step 2

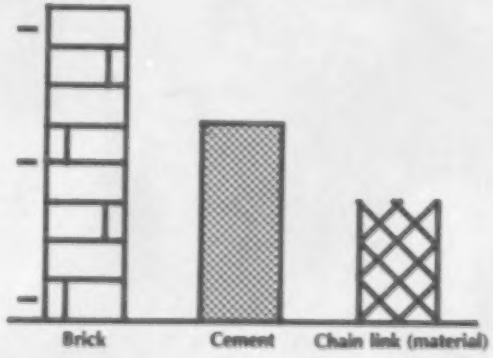
Return to the same walking route. Allow ample time for examination of walls and fences. Encourage recordkeeping (such as crayon rubbings) to record differences in texture, etc.

Step 3

Discuss and record results of findings. For example:

Kind of wall or fence	Plants on each	Animals on each

Heights of walls and fences (in hands)



Q: Why do you think this fence was built? Has it served any other purpose?

Step 4

Q: What are some of the reasons we like fences?

Q: What are some of the reasons we don't like fences?

Draw a picture of a place you like. Draw it first with fences, and again without fences. Which do you like better? Why?

FOLLOW-UP

1. Discuss other kinds of boundaries (hedges, invisible boundaries) and what they are for.
2. Bring in a variety of building materials—brick, wood, chicken wire, etc. What would be the advantages and disadvantages of each as wall or fencing material?
3. Use different materials to build a miniature wall. How do things stand upright?

Adapted from the *Structures and Forces*, "Science 5/13" series, Macdonald-Raintree, Inc.

OL' MAN RIVER

DESCRIPTION
Stream Table—A model stream table is set up in an easily cleanable corner of the classroom. The students manipulate the flow of water, watch changes in the landforms, make predictions, and model real humanmade and natural structures.

OBJECTIVE
D-4. To understand the natural forces that continually shape the environment.

PURPOSE
To give students experience with the natural forces involved in the work of streams in shaping land forms and therefore habitats.

Time	Where
1 hour	Outdoors on asphalt or cemented area, or in a sandy area (not recommended on a lawn or planted area); or indoors in a cleanable space.
Topics	**Materials**
Energy, geography, habitat/community: rivers/streams, soils, water/water quality	Commercial stream table or plastic lined cardboard or wooden box, water, buckets; supporting blocks for changing angle of flow; soil, sand, rocks, twigs, and various other materials to place in the stream flow; kitchen strainer

LEAD-UP/PREPARATION
Secure a commercial stream table *or* prepare a wooden or cardboard box approximately 60 cm or longer and at least 30 cm wide. Make a small hole at one long end for water drainage. Set up materials near a water source. Place a bucket under the hole to catch (and reuse) the water. This can also be done without a box. Use a dirt area outdoors with a source of water nearby.

ACTIVITY
Step 1
Demonstrate water running freely through the stream table apparatus.
Q: What happens when I pour water into the box?
Q: Why does the water run out through the hole?
Q: How could we change the flow of water?
Note: The optimal number of students working at the stream table, depending on its size, is four to six. Arrange some sort of schedule for its use. Five to ten minutes per group is probably enough time for Step 1.
Step 2
Q: How were you able to change the way the water flowed in the stream table?
Record all answers on the board. Possible answers may include: building a dam with rocks, sticking my hand in it, lifting the box higher at one end, or making a tunnel. Have the group choose one method to explore further. Ask a question which requires a predictive answer. For example, Q: "What will happen if you build a real strong dam across the river?" or "What will happen to the trees by the river if more water is added to the stream?" Write the students' predictions on the board; then have the group experiment with methods for changing the water flow.
Step 3
Q: What did you find out?
Compare the students' predictions with their observed outcomes. Discuss any discrepancies.

FOLLOW-UP
1. Leave the stream table set up for several weeks. Allow time for free exploration of the table's possibilities. Explorations may include work in flow dynamics, ocean currents, the effects of islands, changing land forms, sedimentary rock formation, wind flow and movement of materials by wind, glacier modelling, etc.
2. Take a walk around the school. Look for evidence of changes by flowing water.

Adapted from an activity by J. Gex and K. Satter.

NOTES

Built Environment Activities

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BUILT ENVIRONMENT

Issues

Built Environments or human communities have evolved out of the natural environment over the past two to three million years. As innately social animals, we humans have consistently engaged in group efforts to satisfy our basic needs. Our communities stand as dynamic evidence of our efforts thus far. Human communities share many characteristics with other living systems, such as the need for nutrients, energy, food, materials for shelter, and waste disposal. Our techniques for satisfying needs and desires, however, have had much wider impact than those of any other organism. We have reached out over greater areas to gather the resources to support our lifestyles and we have deposited our wastes on the land and in the air and water.

As Built Environments continue to evolve, the quality of life for their inhabitants has improved in some respects and declined in others. We can cite astounding technological advances in areas such as health care, communications, transportation, and the production of goods. Yet, these advances have brought concomitant dilemmas. For example, advances in health care have resulted in the obliteration of many diseases and the prolongation of human lives. However, this has caused increased population growth which, in turn, has resulted in increased competition for natural resources. Advances in communications technology has made it possible to retrieve information from any part of the globe within seconds. Yet, it also contributes to a loss of control, as methods for processing information become more centralized and our individual "data banks" become overloaded. Industrialized countries have advanced exploration and transportation technologies to the point where we have access to natural resources throughout the world. Yet, the distribution of these resources is grossly unequal with 33 percent of the world's population consuming 80 percent of the available resources. Finally, advances in the production of goods have resulted in wider choices, lower prices, and an improved quality of goods for the consumer. Unfortunately, the quality of the work place has suffered as workers often find their highly automated jobs dull and meaningless.

These are merely a few of the technological advances and concomitant problems that have accompanied the evolution of the Built Environment. As we strive to build healthier communities, we must consider the central area of human environments: the cities. They serve as the hub of social, political, and economic activity. As cities grow in size and complexity, they generally become less desirable places to live. Currently, we see evidence of an increased dissatisfaction with city life as more and more people move to the urban fringe. Fortunately, we can also see evidence of efforts to revitalize the city by improving housing and public transportation and reestablishing a sense of community. As we strive to improve the Built Environment, perhaps we should begin by improving the quality of life within our cities.

Three concepts have been defined for enhancing student understanding of the Built Environment. The first considers the dependency of the Built Environment on the Natural Environment. The second considers the evolution of the Built Environment and the influence of societal values on that process. The third stresses a perspective that views the Built and Natural Environments as intertwined through an intimate cause/effect relationship.

BUILT ENVIRONMENT

MAJOR CONCEPTS	OBJECTIVES
A. Built environments depend on resources from the natural environment for survival.	1. To understand that built environments require continuous supplies of energy and resources from the natural environment. 2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments. 3. To understand how technology expands the geographic area from which built environments draw on resources from the natural environment.
B. The design and maintenance of built environments have both reflected and influenced the values, ethics, and lifestyles of the inhabitants.	1. To understand how geographic location, available space, people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment. 2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolis in all parts of the world. 3. To understand how individual and societal values and ethics influence the design of different types of built environments.
C. Built and natural environments function in similar ways and share many basic needs for survival and growth.	1. To understand that continuing supplies of energy are essential for the maintenance of life in both natural and built environments. 2. To understand how both built and natural environments are dependent on the continuous renewal of resources. 3. To understand that built and natural environments are continuously interactive, and changes in one area of the environment can cause changes in many other areas.

BUILT ENVIRONMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand that built environments require continuous supplies of energy and resources from the natural environment.	Students examine natural structures and build some of their own.	Students analyze a collection of items to discover what resources were used to manufacture them.	Students design and keep an energy log for one day.	In a game, students identify the materials and energy consuming processes which went into the building of the school plant.
	2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments.	Students express appreciation for natural resources contributing to their lives.	Students look "beyond" the supermarket shelves at the relationship between the land and food.	Students interview older persons to learn of the sources of resources in the past.	Students design a park for their community.
	3. To understand how technology expands the geographic area from which built environments draw on resources from the natural environment.	Small groups create a mural or mobile showing the origin of the component parts of common items.	Students find out everything they can about chalk: its origin, uses, manufacture, history, etymology.	Students read two river poems and write some of their own. The river is fragile, a metaphor for our own flow.	Students exchange "environmental materials" with another class in a different region.
CONCEPT B	1. To understand how geographic location, available space, and people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment.	Students experience different "population densities" in the classroom and discuss the effects of each situation.	Students design a small town in which they would like to live, and then must resolve the problem of increasing population.	Students shop for "wants" in stores of their own design.	Through word manipulation and other arts media, students share perceptions of societies' successes and/or failures in meeting personal needs.
	2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolises in all parts of the world.	Students draw a picture of a dwelling used in a primitive society and a dwelling from the neighborhood. They list the differences in the dwellings.	Students inventory all of the materials and energy sources needed to play baseball.	Students draw lines between environmental concepts to show interconnections.	Class takes a field trip to a local secondhand store and compares goods of different vintages.
	3. To understand how individual and societal values and ethics influence the design of different types of built environments.	Students discuss and try out ways of physically arranging the classroom.	Students inventory and evaluate the energy-using aids and appliances in their homes.	Eating pretzels as fuel, students investigate transportation alternatives through a game.	Students run an extended role-play based on a Federal Court hearing on land use.
CONCEPT C	1. To understand that continuing supplies of energy are essential for the maintenance of life in both natural and built environments.	Students do physical exercises, observe and build simple machines, and discuss energy needs for various tasks and occupations.	Students perform an experiment with yeast to show that biological functions require energy and that the system loses heat.	Students assess all of the energy that goes into a garden. Several types of gardens are detailed.	Students analyze an oil company's "energy time line" which makes predictions for the future.
	2. To understand how both built and natural environments are dependent on the continuous renewal of resources.	Students examine changes in water, air, and the sun's movement on the school grounds.	Students draw pictures of their dwellings if environmental factors (space, climate, etc.) were changed.	Students assess the artist's values through analysis of landscape painting.	Students outline the environmental implications of the freedom to live wherever they desire.
	3. To understand that built and natural environments are continuously interactive and changes in one area of the environment can cause changes in many other areas.	Students list all of the things a plant needs for survival and then extend these factors to their own cases.	Students examine the differences which exist on different sides of a building with respect to the plant life and other environmental factors.	Students examine human uses of snow in various regions.	Students generate a list of possible environmental happenings and then list the consequences of those.

BUILD IT!

DESCRIPTION
Students examine natural structures and build structures of their own.

OBJECTIVE
A-1. To understand that built environments require continuous supplies of energy and resources from the natural environment.

PURPOSE
To recognize that different structures require different resources and have different uses.

Time	Where
1 hour	Classroom
Topics	**Materials**
Aesthetics/natural beauty, cities, habitat/community: city/urban and suburban, natural resources, urban and rural planning, urban environmental/urban ecology	Honeycomb, abandoned birds' nests, or examples of other natural and human-made structures (or pictures of each); a variety of building materials, such as drinking straws, toilet paper tubes, newspapers, clay, glues, pipe cleaners, cardboard (flat or corrugated), wood blocks, water, ivy, empty thread spools, egg cartons, plants (cattail rushes, etc.), paper fasteners, rubber bands, pins, paper clips, tree twigs, mud, and string.

LEAD-UP/PREPARATION
Bring in a honeycomb and/or examples of different birds' nests.
Discuss what the bees and birds used for building materials.
Q: How did they get their building materials to the building site?
Q: How do the structures differ?
Q: What was each structure used for?
Set up a table and a materials box for each group. Vary the kinds of materials in each box.

ACTIVITY

Step 1
Today we are all going to be builders (architects). We'll divide into builder teams and each team will build a different structure. I will give each team a CHALLENGE. Your CHALLENGE will tell your team what to build *using only your box of materials.*

Step 2
Assign each group a table with a box of materials. Give each group a CHALLENGE.
Some possible CHALLENGES:
- Use your materials to build a structure as tall as you are.
- Use your materials to build a structure that is big enough for one child to sit in.
- Use your materials to build a structure that will support a book at least three inches (7.5 cm) above the table.
- Build a structure that is waterproof.
- Build a bridge that can span two tables placed two feet (60 cm) apart.
- Build a dome-home big enough for a doll.

Step 3
Allow each group to show the class how it met its CHALLENGE.
Q: What materials from your box weren't useful to your group?
Q: What additional materials would have made your job easier?

FOLLOW-UP

1. Take a walk to examine other natural structures, such as ant hills, plants, or the earth's crust exposed by a roadcut. Look at spider webs. Are they all the same? Where do different spiders choose to build them? Where does the spider hide?
2. Take a walk to examine human constructions.
   Q: What shapes do you see?
   Q: What materials were used to build these structures?
   Q: What grows on walls?
   Q: How do roofs look different? What are they made of?
3. Examine and compare patterns in both natural and human constructions. Look for symmetrical patterns; look at arrangements of stones, bricks, windows, and compare to flowers, butterfly wings, leaves, etc.

THANK-A-PLANT

DESCRIPTION

Students express appreciation for natural resources contributing to their lives.

OBJECTIVE

A-2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments.

PURPOSE

To recognize and appreciate those aspects of the natural environment that help maintain our lifestyles.

Time	Where
½ hour immediately following lunch	Classroom or outdoors
Topics	**Materials**
Aesthetics, food chain, environmental values	None

LEAD-UP/PREPARATION

Before participating in this activity, students should be aware of farm plants and animals that we eat.

continued

ACTIVITY

Step 1
Discuss why we celebrate Thanksgiving each year.
"We have many things to be grateful for every day. What are some things in our lunches that we can be thankful for? That we feel good about having?"

Step 2
Examples:
"Thank you, sun, for giving energy to the apple tree, apple, and now me."
"Thank you, bird, for the egg I eat."
"Thank you, fish, for the tuna in my sandwich."
"Thank you, tree, for my lunch sack."
"Thank you, rain, for water to drink."

Step 3
Brainstorm ways that we can give a gift in return to the things we have thanked.
Examples:
Leave breadcrumbs for birds.
Plant an apple seed to make a new tree.

FOLLOW-UP
Discuss gift ideas to make for family, such as pressed flower stationery.

KEEP ON TRUCKING

DESCRIPTION
Small groups of students create a mural or mobile showing the origin of the component parts of common items.

OBJECTIVE
A-3. To understand how technology expands the g ographic area from which built environments can draw on resources from the natural environment.

PURPOSE
To trace the origin of a familiar thing in our classroom environment in order to show the complexity of the chain of supply of our built environment.

Time	**Where**
1 hour	Classroom
Topics	**Materials**
Cities, consumer ecology, energy resources, environmental impact, fossil fuels, habitat/community: city/urban and suburban, human ecology, technology, transportation, urban and rural planning, quality of life	For each small group: art supplies, crayons, paper, mobile supplies (optional)

LEAD-UP/PREPARATION
Ask, "Where does peanut butter come from?" Trace all the steps from peanut plant to factory to grocery store to lunch box.

ACTIVITY

Step 1

Divide your class into small groups of two to three students. Have each group select something in the classroom which will be the subject of that group's study. Let the teacher select the first item. Teacher chooses a pencil.

Q: Where does this pencil come from?

Q: What are the parts of the pencil? What are they made of? (Wood, metal, paint, rubber.)

Teacher draws the pencil on the board and then draws each of its component parts. Next to each part the teacher draws a picture of its place of origin or a symbol representing its place of origin. Small groups repeat the teacher's steps with their own objects.

Step 2

Students create a mural or mobile with arrows showing interconnections.

Step 3

Q: How did your object get from the place where it was put together to here?

Q: Suppose there were no trucks (trains, planes, highways, gasoline, etc.). How could we get the things we need? Could we make them ourselves? Could we use other things for the same purpose?

Q: Was there a time when there were no trucks, etc.? How did the people get the things they needed? Do you think they had as many things as we do?

A values discussion on trade-offs may follow (i.e., trucks provide us with so many things that we consider vital, but they cause problems, too. Is there a way to make things less complex?)

FOLLOW-UP

1. Ask your students to select a favorite toy and, perhaps with the help of a parent, to outline all of the steps in the manufacture and distribution of that item.
2. Ask your students to make a toy out of only those materials they can find in their neighborhoods. Ask them what they would play with if there were no transportation available to bring them toys from far away.

Adapted from *Project Learning Tree*

DENSITY DEN

DESCRIPTION
Students experience different "population densities" within the classroom and discuss the effects of each situation.

OBJECTIVE
B-1. To understand how geographic location, available space, and people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment.

PURPOSE
Students learn that population density and space requirements affect the quality of life in a given area.

Time	Where
2 days	Classroom
Topics	**Materials**
Carrying capacity, habitat/ community: urban, suburban, limits, population (growth/ control)	Food (optional)

LEAD-UP/PREPARATION
Discuss.
Q: Is this room overcrowded? What would it be like if we had ten more students who had to use this room?

ACTIVITY
Step 1
Arrange student desks into a smaller than normal space (a corner of the room, one side of the room, etc.). Tell students that they will be like animals that have large families and have to live in a place where space is limited (crowded). Students should spend a day (or period of time determined by teacher) "living in a crowded habitat."

Step 2
Students then spend an equal amount of time "living in a more spacious than normal habitat" (perhaps ½ of the class could live in another classroom for a day and then trade places; each half could experience the crowded condition by visiting another class, while the other half has more space in its own room).

Step 3
After the experience, talk about it.
Q: How was each situation alike, different, better, worse? What were the problems associated with each?
Q: Was it harder to get along in the more crowded environment?
Q: Did people get in each other's way?
Q: Was it harder to concentrate, etc.?
Talk about animals in the natural environment and have students hypothesize what problems might arise for animals in a community which has reached its "carrying capacity." What is it like for animals whose population density is too low?

FOLLOW-UP
Teacher could distribute food of some sort within each "experimental habitat" according to the square footage of each area. Students then should divide the food as evenly as possible in each situation. (They could role play herbivores.) Then discuss how much space is required to grow food for a given population and what happens when an area is overpopulated (starvation, migration, etc.).

YOUR PLACE OR MINE?

DESCRIPTION
Students draw a picture of a dwelling used in a primitive society and a dwelling from a neighborhood. They make a list of the differences, both internal and external, in the dwellings.

OBJECTIVE
B-2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolises in all parts of the world.

PURPOSE
To show that our society is more complex, at least in terms of material goods, than that of primitive cultures.

Time	Where
1 hour	Classroom
Topics	**Materials**
Adaptation, cultural history, habitat/community: city/urban and suburban environment/ urban ecology	For each student: drawing paper and crayons

LEAD-UP/PREPARATION
The teacher compiles a selection of pictures of primitive dwellings for perusal by the students (this may be done as an adjunct to units on foreign cultures or the Native American culture).

ACTIVITY

Step 1
Distribute a piece of paper and appropriate drawing materials to each student. Have each student divide the paper in half. Explain that on one half of the paper the student should draw a picture of a primitive dwelling, and on the other half a picture of a modern dwelling, perhaps his/her own house or that of a friend.

Step 2
The teacher may want to define the term "complexity" and contrast the concepts "simple" and "complex." Something which is complex has many parts, with perhaps many things happening to the many parts. Something which is simple has only a few parts compared to something which is complex. Something which is complex has a lot of, or a high degree of, complexity. Use examples and "hands on" methods.

Q: Which dwelling has the most parts? Can you list them or count them?

A tepee has a door flap, a smoke flap, decoration, skins, poles, pegs, etc. Your house has a door, windows, chimney, steps, walls, roof, garage, stairs, many rooms, etc.

Q: Which dwelling is complex? Which is simple? Which has the highest degree of complexity?

Step 3
"Our houses are more complex than those of primitive cultures."
For discussion with pictures, drawings or on a walk around the block:

Q: What else do we have that is more complex? What is simpler?

Q: Is there anything we have that is simpler than that which primitive people had?

Q: Which is better to have—something simple or something complex? Why? Discuss values.

continued

FOLLOW-UP

To show concept of complexity more clearly, make two lists—one for the primitive dwelling and one for the modern dwelling containing the "parts" of each. Have students connect correlated parts; for example, door = entry flap and paint = decoration.

List 1 (Primitive)	List 2 (Modern)
flap	paint
poles	walls
decoration	door
skins	window
etc.	etc.

IT'S YOUR SPACE

DESCRIPTION

Students discuss and try out ways of physically arranging the classroom.

OBJECTIVE

B-3. To understand how individual and societal values and ethics influence the design of different types of built environments.

PURPOSE

To allow students to experience the consequences of their choices.

Time	Where
2 45-minute periods spread over a week	Classroom
Topics	**Materials**
Quality of life, urban environment/urban ecology	Butcher paper, crayons

LEAD-UP/PREPARATION

This activity might best be done at the beginning of the year. The teacher is advised to establish his/her own requirements for the classroom arrangement. What aspects of the physical arrangement do you feel are necessary? (Perhaps location of your desk, a space for focusing the whole class on a chalkboard, etc.)
Try to determine what you will and will not allow to be rearranged *before* discussing rearranging the classroom with the students.

ACTIVITY

Step 1

Introduce the idea that we arrange our homes so that we can live comfortably and have space to do the things we enjoy doing. Discuss areas of the home we set aside for special uses (T.V. room, sewing room, kitchen, etc.). "Now let's consider what we use our classroom for." (List answers on board: reading quietly, sharing, playing, watching films, etc.). "How could we best set up the room so that we can comfortably get those things done?" (Now is the time to introduce any restrictions you may have on the physical arrangement).

Step 2

Divide the class into groups of three to five. Have each group draw a picture of how it would like to arrange the classroom so that the class can get things done in a way that's comfortable for all.

Q: Where shall we put desks?
Q: Where will we hear stories?
Q: Where will we keep our personal things?
Q: Where will we do group work, etc.?

Step 3

Allow each group to share its picture with the rest of the class. After all groups have had their turn, vote on which part of each plan the class will try (choose at least one part of each plan). Draw a big picture of the plan to see how it fits together.

Step 4

Rearrange the classroom according to the plan. Try living with it for one week. At the end of the week, reevaluate your plan. What is working? What is not working? How shall we modify our arrangement to make it work even better?

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FOLLOW-UP

Take a walk around the neighborhood. How do people use their space? Do they have yards? What are they used for? Do they have fences? Why? Do they have garages? Gardens? What can we find out about people just by looking at how they arrange their home environment?

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MR. AND MS. MACHINE

DESCRIPTION
Students do physical exercises, observe and build simple machines, and discuss energy needs/usage for various tasks and occupations.

OBJECTIVE
C-1. To understand that continuing supplies of energy are essential for maintenance of life in both natural and built environments.

PURPOSE
To learn that we consume energy in our daily activities.

Time	Where
3 20-minute sessions	Classroom
Topics	**Materials**
Energy; energy resources	Top or gyroscope, empty thread spool, rubber band, toothpicks

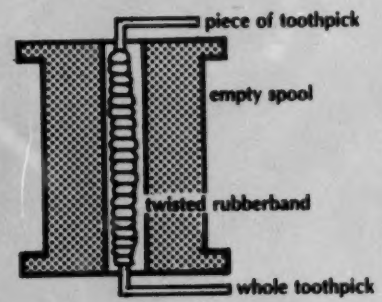
LEAD-UP/PREPARATION
Examine how our bodies use and consume energy by doing the following (older students test pulse before and after):

- Count how many sit-ups or push-ups you can do before you're tired.
- Stand, then bend knees half-way, and hold skiing pose until you're tired.
- Count how many times you can hop on one foot until you're tired.

Q: What part of you did the work in each exercise?
Q: Why couldn't you keep up each exercise forever?
Q: How did the working part of your body feel at the beginning? at the end?
Q: How did your pulse feel? Why?

ACTIVITY
Step 1
Demonstrate a top or gyroscope (or collect several so the students can try them).
Q: What is doing the work? What makes the top go around?
Q: Why does it stop?
Q: How could we make it go again?
Q: How did the top's movement change as we watched it?

Step 2
Have each student make a spool racer.



The racer's "engine" is a twisted rubberband.

Step 3
Discuss parts of body that "kinds" of activities or work use for different tasks.

1. Simple, daily tasks like brushing teeth, taking out garbage, playing tag, etc.
2. Occupations like being a dentist, use the mind, fingers, eyes, arms, back, etc.

Have students ask their parents what parts of their bodies get the most tired from the work they do each day at home or on the job. Perhaps make a simple interview sheet of class-generated questions so class members will ask some questions of their parents as a homework assignment.

FOLLOW-UP

1. Take a walk to look for evidence of animals and people doing work.
2. Take a walk to look at machines doing work for people.
   Q: What makes the machines go?
   Q: Do they ever stop? Why?
   Q: What would make them go again?

CHANGES IN A DAY'S CLIMATE

DESCRIPTION

Students examine changes in water, air and the sun's movement on the school grounds.

OBJECTIVE

C-2. To understand how both built and natural environments are dependent on the continuous renewal of resources.

PURPOSE

To explore climatic conditions in built and natural environments.

Time	Where
½ hour in a.m. ½ hour in p.m.	Classroom or outdoors around school
Topics	**Materials**
Ecology, energy, solar energy, water/water quality, weather/ climate	Chalk: CHALLENGE 1; 4 rags, junkbox: CHALLENGE 2; 4 sponges: CHALLENGE 3; 4 rulers, crayons

continued

ACTIVITY

Step 1

"We're going to be investigators trying to find out more about our surroundings. You will each work with your CHALLENGE and be ready to explain to the class what you found out."

Divide class into teams of four to five and give one CHALLENGE to each group.

Step 2

CHALLENGE 1: Work with a partner first thing in the morning. Go outside to the blacktop and look at your shadow. Draw an "x" on the blacktop and stand on it. Put your back to the sun. Ask your partner to draw a line around your shadow. Then find a new spot and draw around your partner's shadow.

At lunch time go out and draw around each other's shadow again while standing on your "x." Where is your shadow now? Repeat just before school is out.

Q: How are your shadows different?

Q: Do they all point the same way?

CHALLENGE 2: Get a strip of rag and go outside. Stay close to the building. Use the rag to find out if air moves. Try this on the playground; try in other areas around the school.

Q: Does the rag move differently?

Go back to the classroom and make something that shows how air moves. Then go test it.

CHALLENGE 3: You will need four sponges. Put one in the classroom sink. Go outside. Put one sponge close to the building; put one on the blacktop; put one on soil where plants are growing. Check your sponges after lunch and again just before school is out. Collect your sponges and arrange them in order from wettest to driest.

Q: Why are some sponges wetter than others?

Q: If we tried this another time (on a weekend; on a rainy day), would our results be the same?

Step 3

Regroup teams. Allow time for each team to report its findings.

Q: How did the sun, the air, and the water change over the day?

Q: What makes each change? What would make each change even more?

Q: What living things might also change when the sun changes position? The air (wind) blows harder or not at all? The amount of water changes?

FOLLOW-UP

Go outside. Is it sunny? Cloudy? Rainy? Come back into the classroom and make a weather wheel.

PHIL PHILODENDRON

DESCRIPTION
Students list all of the things a plant in the room needs for survival and then extend these factors of the ecosystem to their own cases.

OBJECTIVE
C-3. To understand that built and natural environments are continuously interactive and changes in one area of the environment can cause changes in many other areas.

PURPOSE
To show the relationship between living and nonliving things in the ecosystem.

Time	Where
1 hour	Classroom
Topics	**Materials**
Plants, ecosystem, human ecology	Several classroom plants

LEAD-UP/PREPARATION
The teacher should establish criteria, or at least examples of living and nonliving things. An animal/vegetable/mineral game or a memory circle game (name only living things you saw today) may be of use.

ACTIVITY
Step 1
Display several classroom plants. The teacher says, "These plants are alive just like you and me. Even though they do it in a different way, these plants eat and drink, they breathe, they have a parent or parents, they may have children, they get older, they can get sick, or they can stay healthy. Just like you and me, they are alive."
Q: Can we make a list of the things these plants need to stay alive?
Brainstorm a list of the things that are necessary for plant life. Your list may include soil, water, sunlight, air, plant food, worms, other plants.

Step 2
Ask your students to go through the list and discriminate between living and nonliving things. Also have them list those things which used to be alive. They may use a star for living things, a circle for dead things, and an "x" through a circle for those things which used to be alive.
The list may look like this: (Symbols or pictures may be used instead of words.)

Soil ⊗
Worms *
Sunlight ○
Flower pots ○
Air ○
etc.

Step 3
Q: Which of the same things that plants need do we need?
Have students check them off on their lists.
Q: Can you think of some things that plants need that we don't? How about things that we need that plants don't?
Term—this may be a good lesson in which to introduce the term ecosystem as being everything that a living thing needs to live or which needs that living thing to survive. The above list is part of your classroom plant's ecosystem.

FOLLOW-UP
Q: What does your pet need for survival?
Q: Does a plant in a park or in the wilderness have different needs from those that your classroom plant must have?

Social Institutions and Decision-Making Activities

SOCIAL INSTITUTIONS AND DECISION MAKING

Issues

Western cultures have historically perpetuated two basic themes through their decisions affecting the environment. One is the concept that humans are dominant over nature, and therefore, free to exploit natural resources for their benefit. The other is a concept of stewardship -- that humankind has a responsibility to protect all living things and the land, air, and water. The tension between these two themes is often apparent when environmental issues are debated.

Decisions affecting the environment are usually made within our social arenas. Responsibility for the "public good" is shared by political, legal, economic, educational, and religious institutions. An overview of these major social institutions helps clarify the role of each.

Government has played an increasingly influential role in environmental decision making. Enactment of the National Environmental Policy Act of 1969 (NEPA) established the process for giving environmental concerns consideration in governmental decisions. This act instituted the requirement of environmental impact statements, which mandate the consideration of environmental, as well as economic and technological, concerns in the decision-making process. Laws to control air and water pollution and to expand parks and wilderness areas have also legitimized the concern for a healthy environment. Lobbyists have been influential in shaping our government's environmental policy. Groups such as the Sierra Club, Friends of the Earth, and those representing the interests of developers research the issues and take their cases to governmental representatives. These representatives often listen closely to those with a vested interest in an environmental issue.

Our courts have also played a decisive role in the resolution of environmental issues. The environmental impact statements of NEPA resulted in many suits by environmental groups against federal agencies. In discharging their obligation to interpret the law, the courts have clarified the intent of several environmental statutes.

The business and industry sectors of society affect environmental decisions, not only through lobbying efforts, but through economic enterprises that exploit natural resources. A long-standing debate argues the ethical relationship between business and the environment. Should business be expected to voluntarily engage in practices that diminish its profits? Does business have a responsibility to serve the social good of the community? Business and industry have, without a question, a profound effect on the environment. Yet, whether or not their mechanism for making decisions should consistently include environmental considerations is still largely undetermined.

continued

Business and industry affect environmental issues from another perspective: that of the worker. Labor organizations have found that, in recent years, environmental concerns are sometimes in concert with our own. Labor and environmentalists lobbied together for a bill that regulates the use of toxic substances. A tension continues to exist, however, in situations such as the expansion of Redwood National Park. Labor worked hard against a decision to expand the park because it believed it would destroy jobs.

The wave of enthusiasm that accompanied Earth Day in 1970 led many people to believe that educational institutions would be able to provide citizens with the ability to make responsible environmental decisions. Educators have had a difficult time, however, defining environmental education and deciding where it fits into the school curriculum. Also, schools usually **reflect** societal trends rather than set them. It has, therefore, been difficult to establish a future's-oriented curriculum within the existing educational structure.

When religious institutions have participated in the environmental decision-making process it has been mostly through their educational mission. Church organizations such as The American Friends Service Committee have advocated for personal lifestyles that reflect a concern for the environment. Other efforts, such as the Interfaith Center for Corporate Responsibility, have attempted to push churches into a more active role regarding environmental decisions.

Environmental issues are clearly complex. They are directly influenced by a societal concern for economic well-being and the leadership provided by the major social institutions. Each of these institutions must be responsive to social needs and the environment as they work to make decisions that promote the public welfare.

Four concepts have been identified to develop student awareness of Social Institutions and Decision Making. The first addresses the international ramifications based on continuous use of technological/industrial mode. The second addresses (1) the basis for economic prosperity that can be established through more efficient use of natural resources, and (2) the effects that unlimited short-term prosperity can have on long-term goals for ourselves and for future generations. The third concept addresses decision making about the environment — who makes decisions and how they are made. The fourth concept addresses the identification of sources of information about environmental problems and the real and potential influences which they have in helping to resolve these problems. The final concept addresses the nature of the regulations which are now in effect for controlling use of the environment, how regulations are formulated, and the role of individuals in assuming responsibility for participating in the resolution of environmental problems.

NOTES

SOCIAL INSTITUTIONS AND DECISION MAKING

MAJOR CONCEPTS	OBJECTIVES
A. Environmental problems transcend political entities, state and national boundaries, and cultural differences.	1. To understand how technological advancement and industrial expansion throughout the world are creating massive changes in the environment that have worldwide effects. 2. To understand that population growth in all parts of the world is creating an unprecedented demand for the consumption of natural resources. 3. To understand how national self-interests and societal values and ethics influence international collaboration on environmental issues.
B. The goals for every society include economic prosperity which is based, in part, on the consumption of natural resources.	1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health, welfare, and economic prosperity. 2. To understand how short-term and long-term effects can influence economic decisions related to the use of the environment.
C. Individuals and private groups within our society play important roles in developing public awareness of environmental issues and in monitoring public and private activities in relation to the environment.	1. To understand how interest groups express the values, ethics, and understandings of subgroups within our society. 2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.
D. Educational institutions and communications media are potential sources for the creation of public awareness of environmental issues.	1. To understand that communications media through reporting, advertising, and other programming can widely influence public attitudes about the environment. 2. To be aware that a variety of public and private organizations provide educational programs to influence public opinion about the environment. 3. To be aware of the various avenues which are available for individual expression of concerns about the environment.
E. Environmental law is intended to regulate use of the environment for present and future generations.	1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws. 2. To understand that environmental laws reflect a great many factors, such as economic consequences to an industry, technological development, and short-term and long-term consequences for the environment. 3. To understand that the effectiveness of environmental law is dependent on the extent to which individuals and groups accept responsibility for the care of the environment.

SOCIAL INSTITUTIONS AND DECISION MAKING OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand how technological advancement and industrial expansion throughout the world are creating massive environmental changes that have worldwide effects.	Students interview elderly people from the community.	Through demonstrations and discussions of air and water movement, students discover how pollution can travel from one place to another.	Students use math and map study to outline the impact of land development on wildlife populations.	Students brainstorm positive and negative effects of off-road vehicles (ORVs). Students create lists for the more responsible use of ORVs.
	2. To understand that population growth in all parts of the world is creating an unprecedented demand for the consumption of natural resources.	Students count the number of people in the last two generations of their families. They discuss populations and the need to share resources.	Students simulate how rich and poor countries try to provide for the basic needs of their citizens.	Students participate in a global meal where 1/3 of the group eats an American meal, and 2/3 eat a Third World meal.	In a simulation game, Malthusian principles are demonstrated.
	3. To understand how national self-interests, and societal values and ethics influence international collaboration on environmental issues.	Through artwork and discussion, students describe and examine attributes of groups.	Students compare the belief systems and resultant behaviors of a Native American group and early settlers.	Students consider several hypothetical public policy decisions on food production from disparate points of view.	In a simulation game, students act as a committee gathered from different nations to erect an environmental monument.
CONCEPT B	1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health, welfare, and economic prosperity.	Students learn additional verses to the song "It's a Small World."	Students look at long- and short-term effects of choices they make in purchases. Alternative lists are brainstormed.	Students consider packaging and its effect on the environment. They take a poorly designed package and redesign it.	Students design a segment of one community and take into account economic, energy, environmental, and aesthetic considerations.
	2. To understand how the short-term and long-term effects of resource use can influence related economic decisions.	Students sort and examine classroom waste and recycle selected items.	Students devise other uses for common items in a format game.	Students discuss a fictional work related to the use and abuse of natural resources.	Students examine the pros and cons of packaging in the fast food industry and make recommendations.
CONCEPT C	1. To understand how interest groups express the values, ethics, and understandings of subgroups within our society.	Students sort themselves according to physical attributes and opinions.	Students make a list of appropriate behaviors in outdoor settings. They look at them from the viewpoint of various interest groups.	Students role-play a city council meeting in which they must choose to fund only one of three environmental projects.	Students design logos representing interest groups concerned with environmental issues.
	2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.	Students learn about and make models of endangered animals.	Students create a story from facts only with interest groups viewpoints attached.	Students design a coat of arms representing a citizen's group, governmental agency, etc., concerned with the environment.	Students read position papers put forth by groups on the issue of overpopulation of deer in a small California park.
CONCEPT D	1. To understand that communications media through reporting, advertising, and other programming can widely influence public attitudes about the environment.	Students play describing games to see how well they can communicate a simple message. TV ads are analyzed.	Students role-play different propaganda techniques and examine advertisements for bias.	Students collect energy ads, discuss their purpose and effectiveness, and then design an energy conservation billboard.	Students detail some of the techniques used in the media to influence thought and opinion.
	2. To be aware that a variety of public and private organizations provide educational programs to influence public opinion about the environment.		Students write an editorial on land use in a hypothetical locality.	Students analyze environmental education curriculum materials for bias and manipulation.	Students write for their own class, lesson plans reflecting the biases of selected interest groups.
	3. To be aware of the various avenues which are available for individual expression of concerns about the environment.	Students express their feelings about a forest environment through creative dramatics.	Students examine ways of expressing their environmental concerns and then actually "make a statement."	Students choose an issue and write a petition to bring about change.	Students use a model letter form and write to those who have power over an environmental issue.
CONCEPT E	1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws.	Students examine a classroom problem and the effectiveness of rules.	Students inspect a map showing the land area designated as public parks and open spaces and identify the origins of these designated areas.	Students conduct a mock trial involving thermal pollution of a stream from a nuclear power plant.	Students hold small group meetings to prepare statements on the use of national forest lands for vacation homes.
	2. To understand that environmental laws reflect a great many factors, such as economic consequences to an industry, technological development, and short- and long-term consequences for the environment.		Students take part in a land use planning decision concerning a newly formed lake.	Students simulate an ERA hearing on the use of DDT on the spruce budworm.	Students collect information in a school survey to determine how their school functions, what the power structure is, and who makes the rules.
	3. To understand that the effectiveness of environmental law is dependent on the extent to which individuals and groups accept responsibility for the care of the environment.		Students attempt to equitably divide coastal waters out to a 200 mile (320 km) limit.	Students predict what would happen to a vacant piece of land in the community which was owned in common.	Students analyze the actions of individuals in the environment and make value judgments.

PEOPLE WHO KNOW

DESCRIPTION
Students interview older people from the community.

OBJECTIVE
A-1. To understand how technological advancement and industrial expansion throughout the world are creating massive environmental changes that have worldwide effects.

PURPOSE
To acquaint students with differences of past and present, and to help students realize technology creates change.

Time 3 1-hour sessions	**Where** Classroom, home, neighborhood
Topics Cultural history, history, human ecology, quality of life, technology	**Materials** Tape recorder

LEAD-UP/PREPARATION
Invite an older person to visit the classroom for an interview/discussion. Let the visitor know in advance the goal of the lesson: a comparison of past and present environments and people. Ask the visitor what especially interesting parts of his/her life should be discussed: job, school, family. etc. Brainstorm with class a list of questions (perhaps send questions in advance).

ACTIVITY

Step 1
"Today we have a special guest. We have some questions to ask _____(name of guest) so we can better understand how people's lives have changed since our guest was your age. After we finish interviewing our guest, we will interview each other, using the same questions. Then we can see how life is different now than when our guest was younger."

Step 2
Interview guest; tape record questions and answers.

Step 3
Interview student(s) in one of these ways:
1. Simultaneously with guest—student answers same question after guest.
2. Immediately following the guest's interview.
3. Another time—use tape recorder to review guest and student answers to make some conclusions about past and present life.

FOLLOW-UP
1. Send thank-you notes.
2. Invite guest to upcoming class function.
3. Take field trip to guest's home to hear and see more about past.
4. Students interview members of family and neighborhood using same questions; students share answers they get from all information gathered with classmate and graph it or make a time line of it.

ALL IN THE FAMILY

DESCRIPTION
Students count the number of people in the last two generations of their families. They discuss populations and the need to share resources.

OBJECTIVE
A-2. To understand that population growth in all parts of the world is creating an unprecedented demand for natural resources.

PURPOSE
To introduce the concept of "populations" and the need to share resources within and among populations.

Time	Where
15 minutes in class 15 minutes at home	Classroom and at home
Topics	**Materials**
Carrying capacity, consumer ecology, food/famine, nonrenewable resources, international/global, population quality of life	Family Inventory Sheet (see below)

LEAD-UP/PREPARATION
Prepare the following worksheet for each student to take home to complete with their parents.

All in the Family

1. Count the number of children born to your grandparents.
   - On your dad's side _____
   - On your mom's side _____
2. Count the number of children born to your
   - Aunts _____
   - Uncles _____
   - Mom and Dad _____

ACTIVITY

Step 1
Discuss worksheet with students.
Q: What do we call children of your grandparents?
(Aunts, uncles, mom, and dad.)
Q: What do we call the children of your aunts and uncles?
(Cousins, brothers, and sisters.)

Step 2
These people make up your family. We call any group of people a population, so these people make up the population of your family.
Q: Can you name populations we belong to?
(Our neighborhood, city, country, etc.)
Q: Can you name populations of living things that are not people?
(Worms in our terrarium, birds around our school, etc.)

Step 3
Populations of (birds, people, etc.) must often share things that they need to live.
Q: Can you name some of the things they must share?
(Food, shelter, water, space, etc.)
Q: What will happen if they don't share?

continued

FOLLOW-UP

1. Do the activity entitled "It's a Small World" on page 61.
2. Discuss: If each person in your family ate one pound of hamburger a day, how much hamburger would your entire family eat in one day? In one week? Calculate the amount of hamburger eaten in one day by a family that is twice as big as yours.

GROUP ATTRIBUTES

DESCRIPTION

Through artwork and discussion, students describe and examine attributes of groups.

OBJECTIVE

A-3. To understand how national self-interests and societal values and ethics influence international collaboration on environmental issues.

PURPOSE

To learn that we belong to different groups and we work together to make decisions.

Time	Where
2 one-half hour periods in class, separated by 3-4 days	Classroom
Topics	**Materials**
Habitat/community, interdependence	Large construction paper, crayons

LEAD-UP/PREPARATION

1. Show pictures of different groups at work, at play, at worship, etc. Ask students what each group is doing. Why are they together instead of alone?
2. "Write or draw 10 things that you like to do. Circle those you usually do with others; underline those that you usually do alone."

ACTIVITY

Step 1

"Sometimes we choose to do things *in groups* instead of by ourselves."

Q: What do you like to do with other people? (list on board)

Q: What groups are you part of? (Use list from previous question—do you do things with family, playmates, schoolmates, etc.?)

Q: How are these groups alike? Different?

Step 2

Give each student a piece of construction paper. Ask him/her to choose a group they belong to and draw members of that group. Help each student. Write a heading for the group at the top of each section. *Optional:* Give the students three to four days to gather signatures from members in each group. (If the group is large, can you find out how many are in it?)

Q: Who belongs to your group?

Q: Who else does your mother (or another member of the child's group) spend time with? Does she belong to any clubs? Is she on any teams? Does she work with other people?

These are called *"groups"*—when people get together for a reason.

Q: Are you in more than one group? What does your group like to do?

Q: With which group do you spend a lot of time? Not very much time?

Step 4

"In order for groups to get along, they have rules."

Q: Can you name one rule of your group?

Q: Why does your group have that rule?

Q: How are rules for your group made?

FOLLOW-UP

Use existing playground games to discuss rules, including unwritten rules of students' imaginative play ("Choose," "Jail," "Dolls"). Older students can form a group and make up a game. What are the rules? Have them teach another group in your class.

IT'S A SMALL WORLD

DESCRIPTION

Students learn additional verses to the song "It's a Small World" by Sherman and Sherman, Walt Disney, Inc.

OBJECTIVE

B-1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health, welfare, and economic prosperity.

PURPOSE

To learn a song that expresses the finite nature of natural resources; to introduce factors to be considered when making environmental choices.

Time	Where
3 15-minute periods	Classroom
Topics	**Materials**
Appropriate technology, economics, environmental ethics/values, population limits, resource depletion	None

LEAD-UP/PREPARATION

Teach the class the original song "It's a Small World" (optional).

continued

ACTIVITY

Learn these additional verses by Hallesy and the 1976 LeConte Lodge summer staff:

There is just so much water and so much air
And just so much land and food everywhere
There's so much we must share, oh it's time we're aware
It's a small world after all. (Chorus)

So many people using up so much so fast
We cannot go on as we've done in the past
It is time to confess we have got to USE LESS
It's a small world after all. (Chorus)

On this spaceship earth we are all a crew
And we've got to learn what we must do
It is time we're aware we use more than our share
It's a small world after all! (Chorus)

FOLLOW-UP

1. Discuss each verse.
   Q: Why is it important that we share land and food?
   Q: What should we try to use less of?
2. Sing the song to another class; invite the principal in to hear it.

Adapted from *Manure to Meadow to Milkshake*

CLASSROOM RECYCLING

DESCRIPTION

Students sort and examine classroom waste and recycle selected items.

OBJECTIVE

B-2. To understand how the short-term and long-term effects of resource use can influence related economic decisions.

PURPOSE

To give students experience in and appreciation for recycling.

Time	Where
3 one-half hour periods	Classroom
Topics	**Materials**
Consumer ecology, economics, energy resources, recycling, solid waste	Pencils or another common object, classroom garbage, cardboard boxes

LEAD-UP/PREPARATION

Brainstorm all the ways a pencil, or some other common object, could be used in ways other than for writing. All answers should be accepted without judgment; record answers on the board. Point out that we often use objects for one purpose, when they may be adaptable for a variety of purposes.

ACTIVITY

Step 1

"Let's take a look at some other things that we use every day. Perhaps we can think up ways to use them in another way, instead of throwing them away." Pull a few things out of the garbage: a piece of paper used on only one side, an empty milk carton, a lunch bag, etc. Discuss other uses for each item. "Recycling is the process of converting something to a new use when we are 'finished' with it."

Step 2

Assign recyclers to:

1. Sort paper into two stacks; label a box to store reusable paper.
2. Sort garbage; label boxes for glass, tin, paper towels, cardboard, milk cartons, and INVENTIONS. The INVENTIONS box holds items that may have another use for someone.

Step 3

At the end of the week, examine the items in each box. Weigh the amount of each.

Q: What was used for packaging? Could any of it be used as packaging again?

Examine the INVENTION BOX. Allow students to choose an item and invent another use for it. Discuss the four R's: Reuse, Recycle, Reduce, and Return.

FOLLOW-UP

1. Try to create a "No Garbage" lunch (reusable packaging, etc.).
2. Take a field trip to a recycling center. Take glass, tin, etc., with you.
3. Compost organic waste.
4. Put on the puppet show "Garbage Is No Picnic" in *Manure to Meadow to Milkshake.*

Adapted from *Manure to Meadow to Milkshake*

SORT OF SORTING

DESCRIPTION

Students sort themselves according to physical attributes and opinions.

OBJECTIVE

C-1. To understand how interest groups express the values, ethics, and understandings of subgroups within our society.

PURPOSE

To acquaint students with some of the physical differences which exist in the group and with the fact that they have differences of opinion as well.

Time	Where
1 hour	Classroom
Topics	**Materials**
Diversity, environmental ethics/values	A measuring stick (or use hand span), large butcher paper, newspaper, a graphing board, stickers or stars

LEAD-UP/PREPARATION

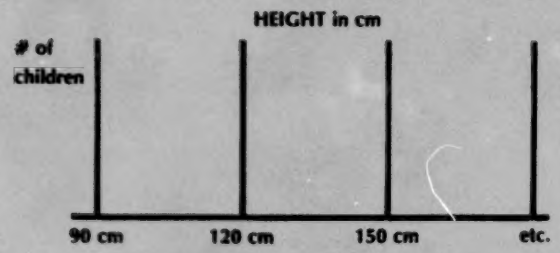
Have a simple graphing system prepared for the students' use. (Use a pegboard and colored pipe cleaners, or colored tacks and a corkboard.)

continued

ACTIVITY

Step 1

Have the group sort themselves into two subgroups, such as blue eyes, brown eyes, etc. Count the number of each and make a bar graph. Have the students individually measure themselves. Make a human graph of how many students are a given height by lining up all students that are the same height. Then, have them graph the results by putting a sticker on the graph to represent their height.



Q: Compare height groups. What number has the most stickers above it? Repeat, comparing heights.
Q: What number has the most stickers by it?
Q: How many very short students are there? Very tall students?
Working in groups of approximately five, have each student trace around his/her right foot on newspaper and cut out the feet. Arrange the group's feet from the shortest to the longest on a long piece of butcher paper.
Discuss: Does it matter if you're tall, short, weigh a little or a lot, have small feet, big feet, etc.?

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Step 2

Sit in a circle. Read the following sentences. Instruct the students to put their thumbs up if they agree with the sentence, put their thumbs down if they disagree, or cross their arms in front of their chests if they aren't sure how they feel.

- Spaghetti tastes better than hotdogs.
- Blue is the prettiest color.
- Reading is fun.
- Baseball is fun.
- Discuss: That individuals can have different ideas but can still work together.

FOLLOW-UP

Have small groups draw a coat of arms to represent their opinion group. What will the group's name be? What animal will be the group's mascot? What two colors will their coat of arms be?

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ENDANGERED ANIMALS

DESCRIPTION
Students learn about and make models of endangered animals.

OBJECTIVE
C-2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.

PURPOSE
To familiarize children with animal species that need human cooperation in order to survive.

Time	Where
2-4 hours spread over several days	Classroom
Topics	**Materials**
Animals, chemical/biological contamination, environment, health and disease, interdependence, preservation, stewardship, wildlife	Pictures of endangered species, film or slides of endangered species

LEAD-UP/PREPARATION
Write for a list of rare and endangered animals: World Wildlife, 1319-18th Street N.W., Washington, DC 20036.
Curriculum materials and posters are also available from: National Wildlife Federation, 1412 16th Street N.W., Washington, D.C. 20036.

ACTIVITY

Step 1
Put up pictures or posters of endangered animals around the room. Discuss one animal each day:
Q: Where do you think this animal lives?
Q: What do you think it eats?
Q: What might eat it?
Q: What sound do you think it makes?

Step 2
Discuss the meaning of endanger (to put in danger), extinct (wiped out, brought to an end, destroyed), and species (a group of animals that are similar or alike). Relate discussion of animals that are familiar to the group, such as dogs and cats.
Q: What would make a certain animal become extinct?
Q: What could people do to help that animal?

Step 3
Show a film or slides of endangered animals and discuss.

Step 4
Have students choose one endangered animal and build a model of it from papier-mâché or clay.

FOLLOW-UP
Repeat, focusing on plants. For a list of rare and endangered plants, write The California Native Plant Society, 2380 Ellsworth, Berkeley, CA 94704.

HUH? WHAT DID YOU SAY?

DESCRIPTION
Students play describing games to see how well they can communicate a simple message. TV advertising is analyzed.

OBJECTIVE
D-1. To understand that communications media, through reporting, advertising, and other programming, can widely influence public attitudes about the environment.

PURPOSE
To show that communication, through media, is not a straightforward thing; that confusion and misdirection may occur in even the simplest of messages.

Time	Where
1 hour	Classroom
Topics	**Materials**
Consumer ecology, economics	Sacks or shoe boxes; pairs of identical building materials (tinker toys, blocks, etc.) for each group of children.

LEAD-UP/PREPARATION
Help students learn to follow verbal clues in order to recognize objects.

1. Display five to ten common objects (toaster, plant, book, toy, etc.). Give the group one-sentence clues similar to the following:
   - It is square.
   - It is shiny.
   - It is made of metal.
   - It runs by electricity.
   - It has two openings in the top.
   - It is used to cook food.

   A: (A toaster)

   Allow individual students to choose objects and give clues to the rest of the class.
2. Try the same activity with objects or animals *not* present in the classroom. Example:
   - I fly.
   - I live near the sea.
   - I eat a variety of things, including fish and garbage.
   - I am white with some black markings.
   - I fly over your school.
   - My name starts with S.

   A: (A seagull)
3. For older students:
   Allow individual students to give descriptions of something in the environment to the rest of the class (if possible, have them write out their clues beforehand).

ACTIVITY

Step 1

Introduction: "In the exercise we just did (from lead-up), we used our eyes or our memories to guess what someone else was describing. Now, we're going to try another exercise where you won't be able to *see* the object, and you won't be able to use your memories because you will *never* have seen it before."

Step 2

Assign, or allow students to choose, a partner. Have the pair decide who will be "leader" and who will be "listener." Pass out a bag of *identical* objects—blocks, tinker toys, etc.,—to each individual in a pair. Instruct the "leader" to build something and describe it to the "listener" so the listener can build it, too. *The listener must remain silent;* s/he cannot ask questions of the leader. Allow approximately five to ten minutes, then. . .

Step 3

Inform the listener that s/he may now ask questions of the leader. After approximately five to ten minutes. . .

Step 4

Inform the leader that s/he may now look over the listener's shoulder as s/he builds. The listener still *cannot* see the leader's structure. After 5-10 more minutes. . .

Step 5

Allow the leader and listener to face each other while the leader gives directions and assembles structure. The listener can also talk. Allow enough time to finish construction.

Step 6

Q: Examine your finished constructions. Do they match?
Q: Was it more difficult to follow directions (and give directions) during the first five minutes? Why?
Q: Did it get easier? Why?
Q: What clues were hard to follow when the listener couldn't talk?
Q: What clues were hard to follow when you couldn't see each other's construction?
Q: What might have made the exercise easier?
Q: When might it be important for us to express ourselves in a way that is clearly understood?
Q: If you can't understand someone, what can you do to let them know?

FOLLOW-UP

Set up a daily (or biweekly) news time for students to report events of interest. Encourage them to report news from around the school as well as interesting events from newspapers or television news. Discuss the difference between *describing* and *giving an opinion*. Allow time for both. Choose two to three students to provide advertisements before and after each news time.

PLANT PERSONIFICATION

DESCRIPTION
Students express their feelings about a forest environment through creative dramatics.

OBJECTIVE
D-3. To be aware of the various avenues which are available for individual expression of concerns about the environment.

PURPOSE
To provide an avenue for self-expression about the environment.

Time	Where
½ hour	Playground or wooded area
Topics	**Materials**
Aesthetics/natural beauty	None

LEAD-UP/PREPARATION
If possible, visit a wooded area to observe sounds, smells, etc.

ACTIVITY
Ask students to move like a tree might if there was a:

- gentle breeze
- violent windstorm
- gentle rain
- hard rainstorm with thunder and lightning
- forest fire
- squirrel running up the trunk
- person climbing it
- person carving on the bark
- person planting it
- person harvesting it

FOLLOW-UP
Students can draw a picture that expresses how a favorite place makes them feel. Have your students personify a kelp forest or other seaweed.

Adapted from *Project Learning Tree*

SCHOOL RULES

DESCRIPTION
Students examine a classroom problem and the effectiveness of rules.

OBJECTIVE
E-1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws.

PURPOSE
To explore the effects of rules that influence the classroom environment.

Time	Where
2 hours, spread over three weeks	School
Topics	**Materials**
Environment, legislation/ regulation, human ecology	Materials needed will be determined by the class

LEAD-UP/PREPARATION
Teaching young students about *laws* is a formidable task since their perspective of what is "right" and "wrong" seems to develop in stages (linked to intellectual development). Perhaps it is useful for the teacher to spend time learning how his/her students view "right" and "wrong" behavior, and how they define and implement rules in their attempt to ensure "right" behavior. By allowing the students time to play games, both active/physical and passive/board games, the teacher can informally question students as to what *rules* they follow and how these rules are enforced. With young students, the teacher may find that a group of students playing "together" hold varied perspectives of the rules.

ACTIVITY

Step 1
To ensure enthusiastic participation, choose a classroom problem by group consensus; e.g., sharing toys, waiting turns, etc.
Q: What are the rules about (selected problem) we now use?
Q: Why is it necessary to have rules about (selected problem)?
Q: Are our rules fair?
Q: Should any of them be changed?

Step 2
Brainstorm all of the things we could do to try to get rule breakers to follow the rules (ad campaigns, stricter punishment, consultation with individual rule breakers) or to influence the rule *makers* to change unfair rules.

Step 3
Create an action plan to see that compliance with the rules is increased.

Step 4
Allow one-to-three weeks to see if there has been an improvement in compliance. Discuss progress frequently.

Step 5
Have an evaluation discussion:
Q: Did our plan work?
Q: What should we *change* in order to make it work better? (Examine needed compromises on group's plan.)

FOLLOW-UP
Use the *New Games Book* to play games that require cooperation.

SPECIAL NOTES
Familiarity with L. Kohlberg's stages of moral development may also help the teacher understand how young students view "right" and "wrong" behavior. Understanding Kohlberg's theoretical model can help us be more tolerant of students' inconsistent decisions between right and wrong.

Energy and Environmental Resource Management Activities

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ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT

Issues

The ultimate goal of resource management in the present-day context is to increase the productivity of our environment to meet the needs of an expanding population. On the underside of that optimistic outlook there is another equally urgent goal to ensure our survival. One concept emphasized in the section of the Natural Environment is the importance of habitat for the survival of any species of wildlife. In this section, that concept is applied to the human race and particularly to those of us who share in that part of the planet called California.

We are all familiar with the type of resource management that results in building a dam to provide for a continuous flow of water to an urban area, or a public works canal that carries water to farmlands for irrigation. And most of us have experienced the need to conserve water or gasoline when there are shortages. But after the dam was built, we discovered that fish no longer came up the rivers to spawn, and when the farmlands were irrigated, we discovered that salinization due to poor drainage was reducing the productivity of the land. One attempt to control the environment and manage a single resource led to other problems and the need for managing other resources. When the water or gasoline shortage abated, we knew we were still vulnerable and our lifestyles could be affected almost any time by another scarcity. Along the path of these experiences, the meaning of resource management has changed from a one-problem approach to a holistic outlook and a tacit recognition that humans are, in fact, only members of a biotic team.

A holistic approach to resource management is based on the recognition of at least two realities about our environment. One is that the environment is infinitely complex and any system for managing its resources must take into account all the ramifications that ensue from any intervention into its operation. Another is that we are confronted with the reality that we are approaching the economic limits of nonrenewable resources such as oil and gas. We face the challenge of finding a new basis for continued prosperity and a satisfactory quality of life. The answer lies in an increased reliance on and caring for renewable resources, such as forests, fisheries, farm soils, and rangelands. Underlying this shift in emphasis is another recognition that our natural resources constitute our true wealth now and for future generations.

Four concepts have been defined for developing students' understanding of resource management. The first is concerned with conservation, one way in which the real supply of resources can be increased by consuming less. The second is concerned with renewing resources, the problems involved in establishing continuously renewing supplies of resources. The third is concerned with understanding past — and present-day models for resource management and the lifestyles that include this as part of everyday living. The fourth is a description of the model for resource management that is being developed in California through the state government. A selected number of resource management departments are described in terms of the long-range problems with which they are dealing. Their particular departments were selected because their long-range planning needs so clearly exemplify the range of environmental problems which our society, in general, is confronting. Other departments within the Resource Agencies are also described more briefly and a number of educational materials that are available from each agency are listed and described. Detachable, addressed postcards for ordering materials or requesting information from each department accompany the materials list.

ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT

MAJOR CONCEPTS	OBJECTIVES
A. There are a number of historic and present-day models which can be used in developing resource management programs.	1. To understand how groups of people historically have managed scarce natural resources for their collective benefit. 2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.
B. Conservation is the most immediate way of increasing the real supplies of a natural resource. Conservation practices focus on more efficient uses of natural resources.	1. To be aware of the importance of non-renewable resources for maintaining our lifestyles. 2. To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources. 3. To become aware of the potential for recycling and reclaiming resources.
C. Some resources are renewable and can be maintained so they will provide consistent and continuous supplies of resources as they are needed.	1. To be aware of the role of technology in renewing and recycling resources. 2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires. 3. To be aware of the complexity which often exists in resource management, especially when intergovernmental and intercorporational cooperation is required. 4. To understand the necessity of long-range planning for resource management in relation to the assessment of future needs.
D. Resource agencies and their departments maintain the productivity of our natural resources into the future.	See California State Resource Agencies section.

ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand how groups of people historically have managed scarce natural resources for their collective benefit.	The teacher gathers and brings to class natural materials used by California Native Americans.	Students participate in a decision-making simulation game taking place on a wagon train.	Students are presented with situation cards describing a lifestyle from the past and present expectations for the future.	Students describe their attitudes toward natural resources from the viewpoint of persons in the distant past.
	2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.	Students simulate the effects of population growth.	Students monitor TV commercials and discuss how consumption patterns have changed over time.	Students study maps of an imagined wetland island. They note changes over time, and make recommendations for the development of the island along more environmentally sound lines.	Students research the changes which have occurred in local commute patterns since World War II.
CONCEPT B	1. To be aware of the importance of nonrenewable resources for maintaining our lifestyles.	Students monitor their classroom water use and take action to reduce water use.	Students conduct an energy audit of their classroom and discuss energy waste.	Students take a look at the air pollution problems of Los Angeles and determine ways in which Angelenos might improve the situation.	Students learn to read electric and gas meters. They do an energy audit of their homes.
	2. To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources.		Students conduct a survey to assess attitudes and incentives related to recycling.	Students examine the bill which made the 55 miles per hour speed limit the law, its hows and whys.	Students state their opinions on the many "ways" to save a tree and rank them on effectiveness and desirability.
	3. To become aware of the potential for recycling and reclaiming resources.	Students make paper from used paper, cardboard and other materials.	Students choose a household container and research how it was made and what happens when it is "thrown away."	Students put together a picnic lunch with the minimum amount of unrecyclable materials, a "garbage free" lunch.	Students take a fact-finding trip to a local recycling center and interview the persons involved in the recycling effort.
CONCEPT C	1. To be aware of the role of technology in renewing and recycling resources.	Students take a short field trip to a Christmas tree farm or sales lot. Students make decisions about Christmas trees.	Students visit a lumberyard and interview a lumberyard worker.	Students make musical instruments out of forest materials.	Students learn how agriculture alters the biosphere and how much land surface has been altered by human activity.
	2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires.	Students examine their shoes, consider how shoes are made, and identify the variety of materials used.	Students take a survey of things at school, how these things got there and the fuel used for moving these.	Students learn rudiments of road map reading and discuss transportation in California, past and present.	Students design environmental, energy and resource management games requiring technological solutions.
	3. To be aware of the complexity that often exists in resource management, especially when intergovernmental and intercorporational cooperation is required.	Students plan and manage a classroom garden.	Students are each given control over one major resource. They negotiate with other students to get needed resources.	Students research episodes of California history concerned with resource management, such as The Great San Francisco Egg War.	Students discuss a hypothetical situation showing the trade-offs necessary to, and common in, resource management.
	4. To understand the necessity of long-range planning for resource management in relation to the assessment of future needs.		Students compare their "lifespans" to the "lifespans" of selected resources.	Students design a community emphasizing the relationship between the work place and the residence.	Students organize an expedition walking trip of 200 hundred miles (320 km) or more, using a systems approach to planning and problem solving.
CONCEPT D	See California State Resource Agencies section.				

NATIVE PLANT USES

DESCRIPTION
The teacher gathers and brings to class natural materials used by California Native Americans.

OBJECTIVE
A-1. To understand how groups of people historically have managed scarce natural resources for their collective benefit.

PURPOSE
To introduce ways in which early cultures relied on the natural environment to meet their needs.

Time	Where
½ hour	Classroom
Topics	**Materials**
Adaptation, consumer ecology, cultural history, human ecology, land use/land use planning, natural resources, plants	Acorns (available in fall), cattail or tule reeds (available year-round), soaproot (available in spring and summer), pictures of California Native Americans gathering food, building homes, making tools, etc.

LEAD-UP/PREPARATION
Gather natural objects; many are available from natural food stores. Acorns were the major staple food for the California Native Americans; they were used in breads, mushes, and stews. Gather acorns in the fall; reject any with little holes or dark spots (signs of worms). To further cull acorns, put them in a bucket of water. Wormy or hollow ones will float.

Cattail was also an important food source in California. The entire plant is useful: the roots, the inner layer of the stalk, the leaf tips, the pollen, the bloom spikes, and the seeds are all edible. The fluff was used for diapers, insulation, and tinder. The long slender leaves were popular as a weaving material for mats, roofs, and chair seats.

Soaproot also had many uses. The bulbous root can be used like soap; it can be washed and peeled, then rubbed between your hands to produce a lather. The dried root fibers were used to brush acorn meal into a container after grinding.

ACTIVITY

Step 1
Display the natural materials—perhaps most easily done at a learning station. Allow 10-15 minutes for students to examine materials; encourage them to touch and smell the different materials.

Step 2
Gather students in a circle.
Q: What did you find out about these things? How did they feel; smell?
Q: Where do you think they came from? (The grocery store?)

Step 3
"These are things that were really important to the people who lived here a long time ago. When California Native Americans lived here, there weren't any stores or houses like ours. So they had to use things they could *find* for food, for making tools, and for building their homes." (Use information from Lead-Up/Preparation to describe how each material was used.)

Step 4
Allow students time to try washing their hands with soaproot, eating cattail shoots, or cracking acorns (they are bitter until ground and leached).

Step 5
Show and discuss pictures of California Native Americans at work, at play, etc. Emphasize their reliance on natural materials.

FOLLOW-UP
Try making acorn muffins—recipes for several common plants are in *Using Wild Edible Plants With Children* (available from U.C. Berkeley Department of Education).

TROUBLE-SHOOT
Many plants are hazardous; therefore, stress to the students that some plants can be harmful. Be certain of the identity of plants used in the classroom. Contact a botanist if you have *any* questions.

Adapted from Using Wild Edible Plants With Children

POPULATION VILLAGE

DESCRIPTION
Students simulate the effects of population growth.

OBJECTIVE
A-2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.

PURPOSE
To introduce the relationship between population growth and resource consumption.

Time	Where
½ hour	Classroom
Topics	**Materials**
Habitat/community: city/urban and suburban, human ecology, quality of life, land use/land use planning, population, urban environment/urban ecology	Squares of felt or paper (one per pair); 8 2"×3" (5×7.5 cm) rectangles of paper per pair

LEAD-UP/PREPARATION
Be sure the group understands the meaning of "increase" and "decrease" by doing the following optional preliminary exercise:
- Give each student strips of paper of different lengths. "Arrange the strips from shortest to tallest. The strips should get *increasingly taller* as our eyes move along the line." (Repeat, using bottles.)
- Watch a balloon slowly deflate. "Is it *increasing* or *decreasing* in size?"
- Use the volume control on the record player to demonstrate increasing and decreasing noise levels.

continued

ACTIVITY

Step 1

Allow students to choose a partner to work with. Give each pair a 8"×11" (20×28 cm) felt rectangle or a piece of construction paper (all pairs should have the same thing). Give each pair eight rectangular pieces of paper approximately 1"×1" (2.5×2.5 cm) and at least 25 paper or plastic counters (or beans).

Step 2

"Once upon a time there was a village where the people were happy and well cared for. They had nice homes (put two rectangles on your square to represent two five-person homes), nice schools (put another rectangle to represent the school), and a movie theater (put a rectangle on your square to represent the theater). They still had plenty of space left over on their land to plant, to farm, and grow food, and space for plants and animals to live. (Count out ten beans. These will be the people. Put them on your land, maybe in school, or out working on a farm.) Other folks heard about this village and moved to the land. Add ten more people on your land."

Q: What will happen at the school? At the theaters? At home? They needed more homes, more schools, and more theaters! (Add two homes, one school, one theater.)

Q: What has happened to the amount of space we use for farms, hiking, playing, etc.?

Q: Will we be able to grow *more* food now that we have more people? Will we be able to have *more* room to play for the increased number of people? The villagers were becoming *increasingly* dissatisfied and *decreasingly* happy.

Q: Now let's finish the story together. What might happen to make the story end happily?

Q: What might be an *un*happy ending to the story?

FOLLOW-UP

1. Choose ten students to be the village people. Have them sit in a semicircle, facing the rest of the class. Put a bowl of ten apples in front of them. Have each student take one.
   Q: Is there food for each member of the village? (Yes)
   Add ten people to the semicircle.
   Q: Is there still enough food for everyone? What can we do to give everyone some food? (Cut apples in half, get more apples, etc.) Discuss consequences of each possibility.
2. Find examples of things outside that are *increasing* (number and size of buds on trees, number of clouds in the sky, etc.), and *decreasing* (something decaying, soil that is being washed away).

CONSERVING WATER

DESCRIPTION
Students monitor their classroom water use and take action to reduce water use.

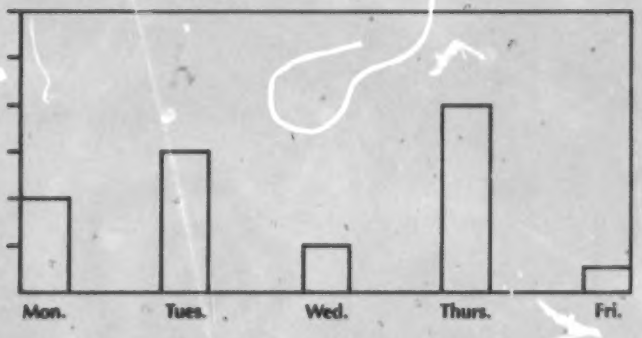
OBJECTIVE
B-1. To be aware of the importance of nonrenewable resources for maintaining our lifestyles.

PURPOSE
To monitor and alter consumption patterns of one resource—water.

Time	Where
15 minutes per day for 5 days	Classroom
Topics	**Materials**
Water, renewable resources, conservation	Dishpan, jar, or pitcher

LEAD-UP/PREPARATION
Set up a system for monitoring water use in the classroom. This can be done by putting a dishpan in the sink to catch all the excess water. Keep a jar or pitcher next to the sink to measure water at the end of the day. Prepare method for charting daily water use.

Sample:
Number of jars of water in sink



ACTIVITY

Step 1
Discuss what water is used for in the classroom (list on board).
Q: How much water do you think goes down the drain each day? One jar full? Ten jars full? How could we find out?

Step 2
Set up a system for collecting classroom waste water (see suggestion under Lead-Up/Preparation). This would be a good time to discuss the importance of water—for growing plants, water transportation, etc. A 12-minute film entitled *My World-Water* is appropriate for grades 3-8 and is available from most local district offices or the East Bay Municipal Utility District.

Step 3
At the end of each day, measure the amount of waste water collected in the sink. Record the results (see suggestions under Lead-Up/Preparation) for one week.

Step 4
Brainstorm some ways for reducing water waste *and* using collected waste water.

FOLLOW-UP
1. Take a walk around the school. Observe other uses of water and evidence of water being wasted. Brainstorm ways for reducing water waste.
2. Discuss ways we use water at home and what we can do to reduce the amount of water being wasted.
3. Although water is a renewable resource by strict definition, it is much overused in some areas, and is in dwindling supply much as if it were a nonrenewable resource. You may want to discuss these two classifications of resources with your second or third graders and bring out the point that water, at least in California, is a special case.

Adapted from *Spaceship School*

MAKING PAPER

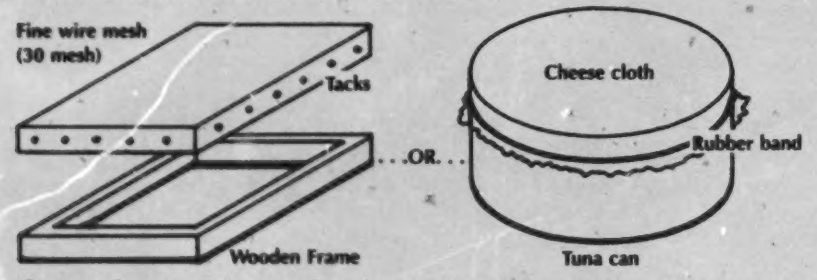
DESCRIPTION
Students make paper from used paper, cardboard, and other materials.

OBJECTIVE
8-3. To become aware of the potential for recycling and reclaiming resources.

PURPOSE
To demonstrate a process of recycling resources.

Time	Where
4 hours spread over a week	Classroom
Topics	**Materials**
Natural resources, recycling, solid waste	For every three students: old paper, cardboard cartons, 1 cup water, 1 tablespoon laundry starch, blotting paper; for class: 3 deckles (see below), rolling pin, basin, egg beater (optional)

LEAD-UP/PREPARATION
Build a wooden deckle or a tuna can deckle:



Make one frame of the wooden deckle slightly larger than the other so one fits over the other.

ACTIVITY
This activity works well if set up as a station for students (approximately three) to rotate to.

Step 1
Tear sheets of paper or cardboard into small pieces—less than two inches (5 cm) in diameter—and put the pieces into a large basin.

Step 2
Add water and laundry starch in proportions of one tablespoon of starch per cup of water. Mix with paper strips by squishing with your hands. Do this until the pulp is the consistency of gravy (an egg beater may be helpful).

Step 3
Dip one frame of the wooden deckle into the pulp mixture until the screen is completely coated with a light layer of pulp. Put the other frame on top of the pulp layer; invert. Carefully press out excess water, then peel pulp from top frame and place it between two pieces of blotting paper.

Step 4
Press out excess water with a rolling pin and allow to dry. Peel the recycled paper from the blotting paper and trim to size.

Step 5
Point out that we have just made something new from something old. Discuss other things that we can recycle by using again or making into something new.

FOLLOW-UP
1. Find a use for your recycled paper.
2. Add bits of natural materials to make the paper attractive—dried leaves, flower petals, seeds, etc.
3. Try making paper from a variety of materials. Which is strongest? Most water resistant? What happens if we add bits of yarn or thread?

Adapted from *Project Learning Tree*

VISIT TO A CHRISTMAS TREE FARM

DESCRIPTION
Students take a short field trip to a nearby Christmas tree farm or sales lot. Students make decisions about Christmas trees.

OBJECTIVE
C-1. To be aware of the role of technology in renewing and recycling resources.

PURPOSE
To show that many industries depend on renewable resources.

Time	Where
2 hours	Christmas tree lot or farm
Topics	**Materials**
Farming, land use/land use planning, renewable resources, resource allocation/ management	None

LEAD-UP/PREPARATION
Arrange field trip to Christmas tree lot or farm.

ACTIVITY

Step 1

Discuss:

Q: Where do Christmas trees come from? (List all answers on board.)

Q: Are all Christmas trees alike? (Show pictures of artificial, live, potted trees, fresh cut trees.)

Q: Why don't we seem to run out of Christmas trees?

"We're going to visit a Christmas tree farm (and/or Christmas tree lot) and find out more about where trees come from, how they differ, and why we never seem to run out of Christmas trees. We will talk to the manager—the person in charge. What are some of the questions you'd like to ask the manager? (Record all questions. Ditto for everyone. Go over questions before visit.)

Step 2

Be sure to have approximately one adult for every five students. Upon arrival, spend 15-20 minutes allowing each group of students (with their adult leader) to actively look around. Each student might try finding:

- A tree taller than you
- A tree shorter than you
- A tree that we can form a circle around, holding hands
- A tree that's crooked
- Two trees that have different types of needles

Regroup with the manager. Allow students to take turns asking questions (take question sheets along and pass them out). Provide time for the manager to add any information s/he considers important.

Step 3

Return to class. Share information gathered on field trip.

Q: If trees were cut from a forest instead of a Christmas tree farm, how might wildlife be affected?

Q: Who depends upon Christmas tree sales to make a living?

Q: Have you seen Christmas trees made from plastic? Are they as pretty as real ones?

FOLLOW-UP
Ask students where they get their trees for home; make a graph.

—artificial
—fresh-cut
—living
—other

Adapted from *Project Learning Tree*

SHOES

DESCRIPTION
Students examine their shoes, consider how shoes are made, and identify the variety of materials used.

OBJECTIVE
C-2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires.

PURPOSE
To familiarize students with the range of materials used to meet a human "need."

Time	Where
Three ½-hour periods	Classroom
Topics	**Materials**
Technology, natural resources	Pictures of early footwear, dots in at least five colors

LEAD-UP/PREPARATION
Pile everyone's shoes in the middle of the floor. Allow each child to select two different shoes and put them on. Each student now has a different shoe on each foot. As a game, have each student find the child with the other shoe for *each* foot and try to stand with their pairs touching! Invite a shoemaker or shoe salesperson to visit the class. Ask him/her to bring along the tools of the trade and to explain his/her job, tell stories, and bring samples.

ACTIVITY

Step 1
Sort and resort the students' shoes according to the following criteria: What they're made of; what color they are; sizes; brands; newness/oldness, etc.

Step 2
Show pictures of footwear worn by Native Americans, pioneers, and early settlers. What did they make shoes out of? Where did they get the materials? How were their shoes different from ours?

Step 3
Pass out colored "stick-em" dots. Have each student put a different color dot on each material making up his/her shoe. How many and what kinds of different materials are used to make shoes?

FOLLOW-UP
Older students can list the materials that make shoes and find out where each material comes from.

CLASSROOM GARDENING

DESCRIPTION
Students plan and manage a classroom garden.

OBJECTIVE
C-3. To be aware of the complexity that often exists in resource management, especially when intergovernmental and intercorporational cooperation is required.

PURPOSE
To allow students to manage a renewable resource: a garden ecosystem.

Time	Where
An ongoing project	Schoolyard
Topics	**Materials**
Consumer ecology, farming, food chains, gardening, human ecology, interdependence, land use/land use planning, resource allocation/management	A plot of ground near water source, plant seeds and seedlings, garden tools (spades, shovels, etc.)

LEAD-UP/PREPARATION
A class garden can serve as a logical extension of the classroom, where learning is applied. A successful gardening experience demands coordination among the teacher, the school administrator, and parents. The teacher must have a well thought out plan; the administration and parents should be informed and supportive of that plan. With those prerequisites met, a classroom garden can provide opportunities for students to participate in planning and managing the garden; they can observe growth, change, and cycles.

To begin your classroom garden, choose a small plot on the school grounds *or* build a 5' × 5' (1.5 × 1.5 meters) square garden box, and fill with soil. (If those choices are impossible, try containers, such as ½ of a barrel or a garbage can.) Collect tools from parents.

ACTIVITY

Step 1

Q: How many of you have a garden at home?
Q: What can you find in your garden?
Q: We're going to use our plot of land to make a class garden. (Show pictures of gardens.)

Step 2

Q: What might we find out by watching our garden grow? (List ideas on board.)
Q: What plants need to grow?
Q: What birds will visit our garden if flowers will grow?
Q: What will seeds turn into?
"Let's divide up into garden groups (2- children in each). Each group will have a large piece of butcher paper and crayons. Working together, draw how you would like our garden to look." (This might be done outside in view of the plot.)

Step 3

(Display all the pictures.)
"Looking at each garden, let's take the best ideas from each." (List on board those characteristics that the group wants included in its garden.) Narrow choices down so that the result is a simple, well planned garden. Allow for some mistakes to be made.

Step 4

Assign new garden groups, according to interest:
- Preparing soil (digging, breaking up clods, etc.)
- Buying seeds (perhaps after school with a parent)
- Planting seeds (everyone may want to do this)

Q: In what order do we need to do these tasks?

Step 5

Devise simple methods for measuring and recording growth. Discuss progress of garden on an ongoing basis.

continued

Example:

What we planted	What grew	What did not grow
Peas	x	
Marigolds	x	
Radishes	x	
Corn		x
Acorns		x

Discuss ongoing care of garden:

Q: What might we do to prevent pests (snails, unwanted birds, etc.) from visiting our garden?

Q: How can we make sure our garden will be cared for—be watered, weeded, etc.—on a regular basis?

Q: Who will care for our garden over vacation?

Q: How can we prevent other people, dogs, etc., from ruining our garden?

Q: Who gets the food from our garden?

Q: Which plants required the most water? If water conservation is a goal in your garden, can you suggest practices to achieve reduced water use?

FOLLOW-UP

Resources—

Skelsey, Alice, and Huckaby, Gloria. *Growing Up Green*. Workman Publishing Co., New York ($4.95)

Smith, John D. *Bringing Home the Bacon: School Gardens and Home Careers in Urban Farming*. Ranchovejar, Inc., 37 Mountain Drive, Santa Barbara, CA 93103 ($2.50)

Carolyn Libby at the Farm and Garden. Vallejo Unified School District, 211 Valle Vista Street, Vallejo, CA 94590

APPENDIX

SOURCES OF CLASSROOM ACTIVITIES

- **CAPTAIN HYDRO**
  Produced by
  East Bay Municipal Utility District
  P.O. Box 24055
  Oakland, CA

  Distributed by
  Office of Water Conservation
  Department of Water Resources
  P.O. Box 388
  Sacramento, CA 95802

  Captain Hydro is an upper-elementary workbook promoting water conservation. The student activities draw from many subject areas. East Bay Municipal Utility District has prepared Captain Hydro and other K-12 curriculum materials as part of Project Water.

- **CLASS PROJECT**
  National Wildlife Federation
  1414 Sixteeneth Street, N.W.
  Washington, DC 20036

  CLASS Project is **C**onservation **L**earning **A**ctivities for **S**cience and **S**ocial Studies. These activities focus on environmental issues such as land use planning, solid waste management, and hazardous wastes. They are aimed at the junior high student.

- **ENERGY, FOOD AND YOU**
  Washington State Office of Public Instruction
  Office of Environmental Education

  Energy, Food and You is an interdisciplinary curriculum for secondary schools. It presents issues related to global food production and food-producing resources.

- **ENERGY LEARNING CENTER**
  Chevron USA, Inc.
  595 Market Street
  San Francisco, CA 94105

  The **Energy Learning Center** is a teaching unit aimed at introducing basic energy information and energy issues to students in grades 6-8. It is a

packet of 18 "fact sheets," a time line, a poster, a teacher's guide, and activity duplicating masters.

- **ENERGY AND MY ENVIRONMENT**
  Governor's Energy Office
  Tallahasee, FL 32301

  Energy and My Environment is a K-12 energy education curriculum in three teachers' guides (K-6, 7-9, 10-12). The activities are organized around seven conceptual schemes.

- **ENVIRONMENTAL EDUCATION ACTIVITIES MANUAL**
  Edited by William Stapp and Dorothy Cox (1974)
  30808 LaMar
  Farmington Hills, MI 49024

  This six-volume activities manual is designed to provide K-12 experiences that promote basic environmental education concepts. Each volume has activiites to (1) develop sensitivity toward the environment, and (2) recognize problems, develop problem-solving skills, and take action to solve environmental problems.

- **GREEN BOX**
  Environmental Education Program
  Humboldt County Office of Education
  901 Myrtle Avenue
  Eureka, CA 95501

  Greenbox is a kit containing student activity cards, teacher booklets, program philosophy, and rationale. It is an individualized program for grades K-8; each card gives three activities (K-3, 3-6, 6-8) for the same concept.

- **IOWA DEVELOPED ENERGY ACTIVITY SAMPLER (IDEAS)**
  Iowa Department of Public Instruction
  Grimes State Office Buding
  Des Moines, IA 50319

  IDEAS consists of six secondary (grades 7-12) curriculum guides (home economics, industrial arts, language arts, mathematics, science, and social sciences). The curriculum is multidisciplinary and centers on incorporating energy topics into these six curriculum areas. IDEAS is

sponsored by the Iowa Energy Policy Council in cooperation with the Iowa Department of Public Instruction.

- **LAW IN AMERICAN SOCIETY**
  Journal of the National Center for Law-Focused Education
  Law In American Society Foundation
  33 North LaSalle Street, Suite 1700
  Chicago, IL 60602

  This journal is published four times a year. The February 1977 issue presents a series of articles about environmental issues.

- **LET'S RECYCLE!**
  U.S. Environmental Protection Agency
  Office of Water and Waste Managment
  Washington, DC 20460

  Let's Recycle is a booklet of lesson plans for grades K-12. These activities explore topics related to waste disposal. Each short activity description cites vocabulary and questions for discussion.

- **MANURE TO MEADOW TO MILKSHAKE**
  Hidden Villa, Inc.
  Drawer AH
  Los Altos, CA 94022

  Manure to Meadow to Milkshake is an experiential approach to helping students understand the interdependencies between their lives and the natural world. Although it is written by and for the Hidden Villa Environmental Project, it is full of easily adaptable activities, songs, plays, etc.

- **MARINE STUDIES IDEA BOOK**
  The Sea Grant Program
  University of Southern California
  Los Angeles, CA 90007

  The Marine Studies Idea Book is for grades K-6. It follows four central themes that cover the history, mythology, ecology, and politics of the sea.

- **OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES (OBIS)**
  Lawrence Hall of Science
  University of California
  Berkeley, CA 94720

  Published by
  Delta Education
  Box M
  Nashua, NH 03061

  OBIS is written to introduce youngsters to basic ecological concepts through highly motivating activities. These activities are aimed at youngsters from 10-15 years of age, and are primarily oriented toward community-sponsored youth organizations and nature centers.

- **PERSONAL VALUES AND ENVIRONMENTAL ISSUES**
  by Donald Scherer
  Hart Publishing Company, Inc.
  New York, NY 10003

  This book describes activities that help clarify values related to environmental issues. It covers issues of pollution, energy, food, population, and land use. Groups are to examine these issues as they are guided through the process for making responsible decisions.

- **PIONEERS**
  Interact Co.
  Box 262
  Lakeside, CA 92040

  Pioneers is a simulation activity that involves students in making decisions on a wagon train. Students work together around problems encountered on their journey westward.

- **PROJECT LEARNING TREE (PLT)**
  American Forest Institute
  1619 Massachusetts Avenue, N.W.
  Washington, DC 20036

  Cosponsored nationally by the Western Regional Environmental Education Council, **Project Learning Tree** is a supplementary program designed to complement existing curricula. PLT includes two activity guides: one for grades K-6 and the other for grades 7-12 made available through workshops. For information on workshops and local facilitators, contact Project Learning Tree, c/o Salina Star Route, Boulder, Colorado 80302.

- **PROJECT WILD**
  Salina Star Route
  Boulder, CO 80302

  Project Wild is in its early formative stages, intended to be published in 1985. It will be a supplementary program designed to promote an understanding of wildlife. Project Wild is cosponsored by the Western Association of Fish and Wildlife Agencies and the Western Regional Environmental Education Council.

- **SCIENCE 5/13**
  Macdonald Raintree, Inc.
  205 West Highland Avenue
  Milwaukee, WI 53203

  The **Science 5/13** books are for teachers to help children from 5-13 years learn science through investigative techniques. The lesson objectives link closely to Piagetian stages of conceptual development.

- **SCORING THE LOS ANGELES LANDSCAPE**
  UCLA Urban Environmental Education Project
  University of California
  Los Angeles, CA 90024

  Scoring the Los Angeles Landscape is designed to help learners become attuned to urban ecology. Activities cover components of urban systems, such as air, energy, transportation, population, etc. These activities are appropriate for use by teachers of secondary students.

- **SHARING NATURE WITH CHILDREN**
  by Joseph Bharat Cornell
  Anada Publications
  900 Alleghany Star Route
  Nevada City, CA 95959

Sharing Nature with Children is a collection of nature-awareness games for anyone who spends time with children. The games are simple ways to help children know nature's ways. Some are purely sensory experiences, some explore ecological principles, and some are just for fun.

- **SHAVER'S CREEK ENVIRONMENTAL CENTER**
  Parks and Recreation Department
  The Pennsylvania State University
  University Park, PA 16802

  Shaver's Creek Environmental Center operates a nature center and a resident outdoor school program—both serve as a laboratory setting for PSU students. The resident outdoor program staff designed and field-tested appropriate technology curricula for grades 4-12.

- **SPACESHIP SCHOOL**
  Marin County Office of Education
  1111 Las Galinas Avenue
  San Rafael, CA 94903

  Spaceship School activities are designed for direct use by kids. Subjects covered are energy, air, water, food, transportation, environmental inventories, and environmental monitoring. There are two sets of Spaceship School activity cards, grades K-3 and grades 4-6. The trial edition was developed by the Marin Museum of Natural Science in 1978.

- **SUNSHIP EARTH**
  by Steve Van Metre — P.O. Box 288
  Acclimitization Experiences Institute — Warrenville, IL 60555

  Sunship Earth is an environmental education program for upper elementary students. It is designed for a residential setting and stresses understandings and feelings related to the natural environment.

- **THE NEW GAMES BOOK**
  The New Games Foundation
  P.O. Box 7901
  San Francisco, CA 94120

  The New Games Book is a starting place for those committed to the world of play. It exudes playfulness through creative, open-ended games. The only fast rule of New Games is "play hard, play fair, nobody hurt."

- **USE THIS**
  The Western Regional Environmental Education Council
  c/o Montana State Department of Education
  Helena, MT 59601

  Use This is a product of a joint effort between educators and resource managers. It describes techniques for examining curriculum materials available from resource agencies.

- **USING WILD EDIBLE PLANTS WITH CHILDREN**
  by Carolie Sly and Molly Whiteley — University of California
  School of Education (PDARC) — Berkeley, CA 94720

  Using Wild Edible Plants With Children introduces children to plant uses through hands-on activities. This packet consists of ten cards covering plants common to California.

- **VALUES ACTIVITIES IN ENVIRONMENTAL EDUCATION (ERIC)**
  The Ohio State University College of Education
  1200 Chambers Road, 3rd Floor
  Columbus, OH 43212

  Values Activities in Environmental Education presents activities for clarifying values related to environmental issues. The activities are for grades K-12 and are suggested for science, social studies, and language arts classes.

- **WET AND WILD**
  Marine Education Program
  USC Institute for Marine and Coastal Studies
  University Park
  Los Angeles, CA 90007

  Wet and Wild, a supplementary teacher's guide, is bilingual (English-Spanish), multidisciplinary, and contains ideas for classroom activities, background information, lesson plans, and references. It covers the physical ocean, ocean management, research, biological ocean, ecological ocean, and economic sea. The Marine Education Program also produces the Marine Idea Books for grades K-6 and 7-12.

California State Resource Agencies

California Coastal Commission
631 Howard Street
San Francisco, CA 94105

The Resource

The Coastal Commission, which includes one state commission and six regional commissions, was established by passage of a citizen initiative, Proposition 20, in the election of November 1972. The Coastal Commission was directed to do the following:

- Prepare a comprehensive, coordinated, enforceable plan for the orderly, long-range conservation and management of the natural resources of the coastal zone.
- During the planning period, to regulate development in coastal waters within a 1000-yard shoreline permit area to ensure that improper development would not undercut the plan being prepared.

The essence of the Coastal Plan is that the 1100 miles of California coastline should be treated not as ordinary real estate but as a unique place where conservation and special kinds of development should have priority. The plan is designed to achieve long-term protection and productivity of coastal resources in times of scarcity, as well as in times of abundance.

The Coastal Plan was completed and published in December 1975. Since then, the state and regional commissions have been overseeing the implementation of the Coastal Act of 1976 which grew out of the plan. Under this act, 67 coastal cities, counties, and four major commercial ports are required to develop local coastal programs which include land use plans and zoning ordinances. Once the Coastal Commission has reviewed and approved the plans, local governments will issue their own development grants. When all coastal communities have had their plans accepted, the Coastal Commission will be dissolved. Theoretically, all of these plans should have been completed by July 1981. However, at the time of publication of this Guide, it is anticipated that only one-half of the plans had been developed.

Long-Term Planning Needs

The Coastal Plan includes ten major categories with recommendations under each. These are described briefly as the long-range planning needs developed by the Commission.

Coastal Waters

Improve the productivity of the marine environment through control of overharvesting of marine life through stricter controls on dumping wastes into the offshore waters and through controlling the diking, filling, and dredging of coastal wetlands.

Coastal Land

Protect coastal streams and plan carefully for coastal watersheds by including provisions in local planning for protecting the quality of water feeding coastal wetlands, controlling sand supply and protecting spawning streams.

Retain natural habitat areas through acquisition, recreational controls and the regulation of adjacent development. Many plants, animals, birds, and marine creatures depend on the unique habitat provided by the coast and cannot survive elsewhere.

Encourage coastal agriculture through the alleviation of high property taxes and urban utility assessments, as well as through regulation of zoning and direct economic and technological assistance. The presence of the sea moderates the coastal climate, helping to extend the growing season and protect crops from frost damage. The rich alluvial soils in coastal valleys, combined with the temperate climatic conditions, create some of the finest

and most productive agricultural land in the nation.

Encourage sustained yields in timber production by amending laws to tax timber only as it is cut, rather than taxing the value of all standing trees. Conserve soil and mineral resources by requiring that local building and grading ordinances include effective measures to prevent erosion. Sand and gravel extraction would be barred in environmentally sensitive or highly scenic areas, and site restoration would be required where mining is permitted.

Protect coastal air quality by requiring the cumulative impact of development on coastal air quality to be considered in land use and transportation plans. Major pollution-generating developments, such as refineries, fossil fuel power plants, and freeways, would be excluded from portions of the coastal zone now designated as problem areas for the maintenance of air quality unless there were no more environmentally sound alternatives.

Coastal Appearance and Design

Protect the scenic beauty of the coast by providing guidelines for visually unobtrusive new developments that are subordinate to the setting and use materials that blend with the environment.

Coastal Development

Encourage orderly, balanced development by requiring that new developments be concentrated in areas where the environment can support them with adequate water supplies, sewer services, and adequate road and public transportation capacity. Already developed areas would be favored for new developments. In rural areas not containing significant natural resources, scenic value, or viable agriculture lands, first preference would be given to the development of low profile facilities to serve coastal visitors. Residential development would be restricted to places where other types of development were not feasible. Hazardous industrial activities, such as liquefied natural gas processing words, would be limited to areas where several facilities would be concentrated.

Energy

The plan recommends that the Energy Commission have authority over the siting of new power plants and all other major energy facilities including those for petroleum and for power plants. Power plant sites would have to be justified on the basis of no alternative sites, real need, minimal adverse visual impact, and, where feasible, provision of public coastal areas.

Offshore petroleum development would be permitted only if it is part of a national or western regional developmental plan. The plan also recommends revising current federal leasing practices to provide for withholding approval of offshore petroleum development until the exploration has determined the extent of the fossil fuel available and the environmental impacts from extracting it.

Tanker terminal construction would need to be justified on the basis of need beyond the existing facilities. Oil companies would be encouraged to trade oil supplies in order to reduce the need for new facilities and petroleum transport. Existing harbor areas should be used to accommodate Alaskan oil tankers with drafts of about 65 feet, and all other tankers should be restricted to deepwater terminals away from environmentally sensitive areas. Any new facilities would be developed for multi-company use.

Liquefied natural gas terminals would be restricted to a single operation until the public safety risks inherent in these operations are determined. If new terminals are built, they should be concentrated in already existing port areas.

Transportation

Limit adverse environmental effects of coastal access roads by improving the efficiency of already existing roads, promoting use of public transit, and paying special attention to weekend congestion problems. Coastal roads should include scenic parking areas, rest areas, beach access, and picnic grounds.

Provide for water and air transportation facilities within already existing port areas and avoid filling in wetland areas for this purpose.

Public Access to the Coast

Increase coastal recreation while protecting coastal resources through the location of parking areas that are away from the beach areas but with access. Where coastal communities are unduly burdened with providing visitor facilities, the plan recommends the use of state funds. Of course, all recreational areas would have to accommodate to the environmental capacity of the area to support tourism. Acquisition of additional recreation sites and encouragement of private developments to serve visitors is

recommended to meet the rising demand for use of the coastal zone as a vacation and recreation area.

Encourage recreational boating but protect wetlands by requiring that new or expanded marinas be built in natural harbors, in deep water that is not marsh or wetlands, and in areas dredged from dry land. Dry storage, rental programs, multiple ownership, and other means, are also proposed to provide for more boating while protecting the wetlands.

Scientific and Educational Resources

Protect sites of scientific, historic, or educational value through an intensified effort to identify and provide protection for the coast's historic and archeological resources.

Restoration

Restore degraded coastal areas with a program that would reduce the numbers of undeveloped coastal lots through purchases and consolidation of lots under common ownership. Purchases are recommended to protect areas useable by the public and in areas where costs of extending urban services would exceed the costs of buying lots.

California Conservation Corps
1530 Capitol Avenue
Sacramento, CA 95814

The Resource

The California Conservation Corps employs 1800 youth between the ages of 18 and 23 on a one-year basis, at minimal wage standards, to work in resource management projects throughout the state. After an initial 20-day training period, the corps members are assigned to one of the 25 CCC centers across the state. At these local sites they may work on resource management projects operated under the auspices of any of the departments within The Resources Agency. The corps is also used in conjunction with local, city, and federal projects. Sample projects include forestry clearance, tree plantings, developing urban parks, and fighting forest and chaparral fires.

The California Conservation Corps is always looking for new members since the work term is limited to one year. Anyone between 18 and 22 who is interested may apply through any local Employment Development Department operated by the state government.

California Energy Commission
1111 Howe Avenue
Sacramento, CA 95825

The Resource

In the early 1970s, California faced the challenge of runaway growth in the projected demand for electrical energy. Large numbers of new power plants were being proposed for construction to meet that rapidly escalating demand. By October 1980, however, California utilities had cut their estimates of the levels of demand in the early 1990s by more than half. In that same month, Southern California Edison Company, California's second largest electric utility, announced a new corporate policy of substantial commitment to conservation and renewable energy resources to meet its electric power needs. These developments and similar actions by the Pacific Gas and Electric Company signaled the end of the energy challenge of the early 1970s.

The formation of the California Energy Commission in 1975 was a major step in the state's response to unchecked growth in electrical energy demand. Since then, the Commission has been a national leader in adopting cost-effective energy conservation standards for new buildings and appliances. The Commission has also been a strong promoter of solar and other alternative energy resources. During this period, the California Public Utilities Commission and the state's electric utilities have redirected many of their efforts into conservation and alternative energy resource development.

Energy conservation provides an increase in the real supplies of an energy source. It represents more efficient use of existing supplies and a reduction in the environmental impact that always accompanies the expenditure of an energy source. In fact, energy conservation is equivalent to an increase in the amount of human well-being that can be extracted from the energy supply.

The notion of a decreased impact on the environment is critical. One of the fundamental misconceptions about the relationship between economic growth and energy consumption is that they are parallel and inseparable.

Successful conservation in a number of ways has shown that this relationship is not fixed and economic expansion is possible without increased expenditures for energy supplies and greater negative impacts on the environment.

Long-Term Planning Needs

There are essentially four approaches to energy conservation that have both short-term and long-range effects for our lifestyles.

Through improved technology and/or operating procedures, we can increase the efficiency with which we use the same amount of energy without any decrease in services. For example, many buildings use excessive amounts of energy for heating and cooling because of inadequate insulation. Similarly, different brands of the same appliance can use energy more or less efficiently. The use of smaller automobiles with less weight and improved mileage per gallon is another source of increased energy payoff. Reduced lighting and heating when commercial buildings are unoccupied can also bring about considerable savings in energy expenditures. In each of these examples, the energy savings are achieved with little or no decrease in the services supplied to the consumer, although, as in the case of smaller automobiles, the environmental impact can be reduced significantly.

Different modes can be used for heating and cooling, transportation, packaging products, and increasing the durability of products that extend the efficiency of the energy source.

Freight transportation is an important example of this type of conservation. Although railroads are much more energy efficient for the movement of freight, there has been a steady increase in the use of trucks for this service during the past two decades. Public transportation systems, deteriorating or practically non-existent in many communities, are vastly more energy efficient than the use of private automobiles. Increased durability of such products as the automobile and appliances can also contribute considerably to the long-range reduction of energy consumption. More efficient heating and cooling systems that require less expenditures of energy for the same effects are another source of energy savings. For example, electric heating is very inefficient from the standpoint of energy consumption. Similarly, solar energy used for heating water in residential buildings is much more energy efficient than the use of petroleum. The quantities of heat generated by petroleum are excessive for the amount of energy needed to heat water.

In another dimension, the energy required to manufacture throw-away glass bottles or plastic containers could be reduced through the more energy efficient use of returnable bottles.

The mix of goods and services within the economy can be changed to increase the contributions to income and employment per unit of energy used with some adaptations of our lifestyles.

For example, more sophisticated communication techniques can be substituted for business travel. Less pleasure travel can also be compensated for by a change of emphasis in leisure activities. Other types of motorized recreation such as trail bikes and motorboats can replaced by less energy-consuming activities such as hiking and sailing.

Changes in energy consumption patterns can be brought about through changes which impose restrictions on energy use that directly affect our lifestyles.

The clearest example of this type of energy conservation is the rationing of gasoline. Smaller residences that require less heating and cooling is another example. Car pools, reduced speed limits, and higher taxes on larger automobiles are other examples of how this more drastic form of energy conservation can affect our lifestyles.

The California Energy System of Today

Oil supplies most of the energy consumed in California.

- California uses 1.9 million barrels of oil per day, about 61 percent of the state's total energy use.
- Imports, principally from Indonesia, total 450,000 barrels per day.
- In-state production is the state's largest supply source.
- Transportation sector uses 62 percent of petroleum products.
- Federal price controls are being phased out in 1981.
- World oil prices increased 2000 percent in the last ten years.

Natural gas is California's second largest energy source.

- The southwestern United States supplies over half of the state's needs.
- About 73 percent of home energy used is natural gas.
- Some gas prices will be deregulated by January 1985.
- Only P5 (power plant) users have experienced major curtailment in recent years.

Electricity supplies only ten percent of California's needs.

- Due to normal generation losses, it uses about 25 percent of our fuels.
- Demand growth rates are decreasing.
- Half of California's power capacity depends on oil and gas as fuel. Power plants used 100 million barrels of oil in 1979.
- Electric rates are rising steeply due to high oil and gas prices and capital costs.
- Electric utilities are closely regulated at the federal, state, and local level.

Conservation is a growth area in the California energy system.

- California is a national leader.
- CEC building and appliance standards reduce energy use.
- Individual business initiatives produce most of the conservation in the commercial and industrial sectors.
- Utility load management reduces peak demand for electricity.
- The state is active in developing regional and intercity rail and bus transportation.
- Federal new vehicle efficiency standards have significant effects on Californians.

California leads nation in use of solar energy.

- The major current applications are solar heating of water and swimming pools, passive solar building design.
- The major government action is the 55 percent state tax credit used for 70,000 installations since 1976.
- The solar industry was a $150 million business in California in 1980.

California Energy Extension Service
1600 Ninth Street, Suite 330
Sacramento, CA 95814

California Energy Extension Service

The Resource

When Congress passed the National Energy Extension Service Act in 1977 to set up pilot programs in ten states, they recognized that a neighbor-to-neighbor approach to conservation information might be the "something different" that was urgently needed to convince Americans to change their attitudes, behaviors, and actions towards energy conservation. After all, if your neighbors are talking about conservation and doing something about it, then it's time for everyone on the block to join the conservation effort.

This personal delivery of conservation information is what makes the Energy Extension Service (EES) different from other programs that the U.S. Department of Energy supports. Through the program, Congress expects to gain a better understanding of the barriers to the adoption of energy-saving measures by small consumers and hopes to reduce the impact of fuel shortages and price increases on small consumers.

The California Energy Extension Service is a $1 million federally funded energy conservation action program of the Governor's Office of Appropriate Technology. EES contracts with established local organizations in communities across the state to provide effective energy management services for users of small amounts of energy who have not been adequately served by other federal, state, and utility programs.

Major Coordination Role

EES is charged with mobilizing the resources of people and their ideas, providing technical assistance, filling gaps, providing links between programs and people concerned with energy management, and promoting the use of energy-conserving practices by those programs not traditionally concerned with energy in California. This has led to a number of programs being jointly developed with other agencies.

Management Philosophy

EES is not a passive education or information program, but one engaged in active outreach with personalized, targeted delivery of energy information involving one-to-one contact with people.

Contracts are the mode of funding, not grants, to assure accountability and appropriate use of public tax dollars. Contractors must submit monthly reports and are closely monitored on a business-like basis to assure effective program operation. Evaluation is an extremely important part of each EES program and is used as a management tool by both the contractors and EES staff. Where problems and barriers emerge, programs can be fine-tuned and adjusted accordingly. Contractors are also brought together periodically for verbal debriefing and peer evaluation which has also proven to be an effective learning process and transfer of knowledge in itself.

The demonstrations EES funds focus on developing programs that are transferable to other groups in other locales so that groups interested in operating similar programs don't have to reinvent the wheel.

Energy Education Program

The Energy Education Program is designed for students, teachers, administrative staff and maintenance personnel, all of whom have a role in and responsibility for energy management within a school. This program will develop models for how these individuals' activities can be coordinated to save energy in schools and educate students about energy. To accomplish this objective, a four part program will be implemented: model demonstration contracts with local schools, teacher training sessions, a clearinghouse/resource center, and an evaluation of existing materials and delivery of services. This program is funded by monies from the Environmental License Plate Fund and operated in cooperation with the Department of Education.

Solar Installer Training

EES manages the SolarWork Institute, funded by the Employment Development Department. The Institute provides instructional materials and resource assistance to solar installer training programs operated by community colleges, union apprenticeship programs, and community-based organizations. The Solar Installer's Training Program Manual is being purchased and used widely by training providers, solar businesses, and the general public. Four training programs have been established with Institute assistance

Energy Management Contracts

In 1980, its first year, EES funded programs addressing six types of energy users. Major contracts developed demonstration programs in gasoline conservation, agriculture, and local government. The EES **Community Energy Program** negotiated 20 contracts of up to $40,000 focused on small business, tenants and apartment owners, and underserved populations. All of these focus areas will be continued in 1981, with the addition of energy cooperatives. Major focus areas include:

- **Renters and Apartment Owners**
  Nearly 45 percent of all Californians live in 4 million units of rental housing and many small businesses rent their stores and office space. It is an area of potentially large savings, yet existing federal, state, and utility programs have generally not provided cogent incentives for energy management investment in the rental sector. EES programs vary depending upon the conditions which affect the relationship between the landlord and tenant who is responsible for utility bills.

- **Underserved Populations**
  Certain client audiences are particularly vulnerable to the rising cost of energy. This category develops informational resources and provides assistance for those to whom information is often denied for a variety of reasons. Most of the clients served by these programs are low income, living in substandard housing in need of repair, unable to decipher documents, and perhaps senior citizens or rural residents. The resources and skills often exist within these "communities" to provide their own services, although they are often under utilized.

- **Small Business**
  More than 400,000 small businesses exist in California, each with its own set of problems. For many business people, energy management is not perceived as a critical or high priority issue. Energy costs have been seen as fixed costs, or ones to just pass on to the consumer. Front end costs are perceived as too high, payback is seen as too long, even if the return on investment is 200 percent, and the terms conservation and audits have negative connotations. In addition, the audience is diverse; commercial, retail, and small industrial. Many small business people rent or lease their business space.

  EES Model Energy Surveys in Santa Cruz showed restaurant managers, car dealers, and grocery store owners how to save 30-40 percent in

water heating, 25 percent in heating/cooling and ventilation, and 30 percent in delivery costs.

- **Energy Cooperatives**
  Neary 500,000 Californians are served by consumer cooperatives, many of these being food co-ops. In 1981, EES will be working with the National Consumer Cooperative Bank (NCCB) to create models of sustainable energy cooperatives. Energy co-ops enable consumers to pool their resources in an attempt to deal with the rising cost of energy. Co-ops can be formed to deal strictly with energy-related services and hardware, or these functions can be incorporated into the services provided by housing and food cooperatives. The EES is developing models for all three of these approaches and is investigating the possibility of energy producer co-ops, that is, nonprofit businesses that are owned and managed by the people who deliver these services. The EES money is to be used for technical and informational assistance and the staff and materials required to deliver these services. It is being supplemented by loans that will be paid back to the NCCB for hardware, inventory, etc.

Long-Range Planning Needs

- There is a need to build the capacity to sustain energy management programs and activities in local communities using local resources to meet national needs.
- There is a need to expand the marketing of targeted energy management information to reach tenants, apartment owners, homeowners, small businesses, women minority and ethnic populations, farmers, low income people, youth, and seniors.
- There is a need for better consumer information about:
  - energy conserving devices
  - energy management services, including contractors, energy auditors, shared-energy-savings firms, consultants
- Energy education needs to be infused through the curriculum with energy action programs at every school.
- Local funding of energy conservation and management programs through innovative financing mechanisms needs to be explored.
- Courses should be developed to update contractors and other professionals about energy-saving and alternative energy techniques in new and retrofit constructions for all sectors.
- Women and minorities need to be made aware of and encouraged to select careers in energy management and renewable resources. This extends from well-paying blue collar positions to those at the professional and managerial level.
- Energy management concerns need to be integrated into the comprehensive planning of each city and county.
- Attractive financing mechanisms for consumers and small businesses need to be further developed and expanded.

Department of Boating and Waterways
1629 S Street
Sacramento, CA 95814

The Resource

The Department of Boating and Waterways is the agency that provides service to the boating community in California. The authority to operate and provide services comes from the State Resources Code and the Harbors and Navigation Code. The 1100 miles of coastal waters, over 1,000 lakes and reservoirs, and thousands of miles of rivers are navigated by an estimated 2.5 million recreational boaters annually. Countless others use this resource for a variety of other activities.

The services provided by the Department of Boating and Waterways include development of boating facilities, beach erosion control,

environmental review, waterway planning, safety and education, enforcement, and yacht and ship broker licensing.

Long-Term Planning Needs

Develop and Preserve Public Boating Access

Recreational boaters and other aquatic participants require public access to the waters of the state. As land adjacent to the state's waters is developed by private interests and public access is limited, the need for the acquisition and preservation of public boating access becomes more important. The California Constitution, Article X, Section 4 states that without regard to the mode of aquatic use for any public purpose, the right of free and unabridged use of the state's navigable waters shall be maintained.

To assist the recreational boater in the use of public waters, the Department of Boating and Waterways develops public launch ramps, marinas, and other forms of access. These facilities are created to provide maximum enjoyment for the public with the least possible impact to the environment.

Conflicts Related to Access

The development of public access brings with it some concerns for environmental issues.

Conflicts that occur near the state's waters often include illegal trespass, litter, sanitation, and other similar problems. The acquisition of land adjacent to public waters can often **reduce** local conflicts. Where large-scale development means endangering riparian or wetland ecosystems, special efforts are made to minimize impact, or in come cases, enhance such areas.

Boating Safety

One of the most important functions of the Department of Boating and Waterways is promoting boating safety for the prevention of accidents, loss of life, and property damage. Assistance is provided to all statewide public boating safety courses offered by other agencies, such as Red Cross, U.S. Power Squadrons, U.S. Coast Guard Auxiliary, Scouts, YMCA's/YWCA's.

Educational services are provided to all public schools at a variety of grade levels. Films, coloring books, posters, and safety pamphlets are available without cost. Additionally, a complete high school boating safety course is offered. This course can be used as a separate offering, or as an element of another course. The materials for this course include textbooks, instructor guide, films, examinations, and handouts.

Department of Conservation
1416 Ninth Street
Sacramento, CA 95814

The Resource

As California's population grows, government planning at all levels for the use of land, now and into the future, is critical. Land use planning includes the recognition of geologic hazards (such as faults, landslides, coastal erosion) and other fundamental geologic knowledge (such as the location of mineral resources) which is related to safety and economic well-being of the citizens of California. To make these decisions wisely, planners need to tap different sources of information. Many of those sources are within the Resources Agency and several departments feed information into this process from the different perspectives of their expertise.

The Department of Conservation monitors the conversion of agricultural lands and administers the Williamson Act, a program that protects agricultural land that is in danger of being urbanized. In addition, the Department has an ongoing interest in the preservation and better use of soil resources. Data developed from these programs are made available to resource and land use planners to provide them with up-to-date information on which to base their planning.

The Division of Mines and Geology in the Department of Conservation has responsibility for collecting information about the surface and undersurface area of our landscape, including the location of earthquake faults and valuable mineral resources. Information about the location of mineral deposits is essential to the total picture that is needed in land use planning. Valuable mineral resources could be covered over by development and lost for use. Areas that are mined can be reclaimed for community use.

Two types of geological information are collected and disseminated by the Department of Conservation in the service of land use planning. One type focuses on a broad, general picture of the geologic structure and location of mineral resources throughout the state. Information of this type includes chartings of major earthquake faults. The data can

be used to map out broad geographic areas where it would be safe to situate critical installations, such as dams and power plants.

The other type of geologic information focuses on specific sites. Studies are undertaken to identify land movements within a small area in the case of making decisions for siting a dam and reservoir. Earth shifts are studied over periods of time and estimates are made about the feasibility of a structure withstanding the impact of any earth movements. Many studies on the subject of earthquake faults are conducted in conjunction with local communities throughout the state for this purpose. Other studies are conducted in cooperation with federal agencies as part of broad land use planning at the national level.

One avenue for dissemination of the information collected by the department is through advisory services to local, state, and federal agencies on a variety of topics such as environmental impact assessments and mineral resources development, as well as outer continental shelf development, and the reclamation of mined lands.

A second avenue for dissemination is through publications which include *California Geology*, a monthly magazine, and scientific research reports.

The Department's Division of Oil and Gas has the role of encouraging the wise development of the state's oil, gas, and geothermal resources in a manner that prevents, as far as possible, damage to life, health, property, and natural resources.

Long-Range Planning Needs

As the nation's demand for adequate and reliable sources of energy increases, so has the need for the wise development of our oil, gas, and geothermal resources. The development and use of alternative energy supplies is a vital and growing component of our total energy program, although petroleum fuels will play a major role into the next century.

Many inquiries about oil, gas, and geothermal development are received by the department. As part of a program to handle these inquiries in a thorough manner, a wide variety of publications and maps related to oil, gas, and geothermal operations are prepared and distributed by the publications staff of the Division of Oil and Gas. Among the publications are field articles authored by division engineers and manuals describing recommended field practices written for oil, gas, and geothermal operators. An *Annual Report of the State Oil and Gas Supervisor* contains statistical data including production, injection, and reserve figures. Oil, gas, and geothermal field maps are published with field boundaries, well locations, and some well data. All of these publications are either distributed free of charge or sold at nominal cost.

Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95814

The Resource

The Department of Fish and Game deals with the management of all wildlife resources within the state and coastal marine areas. Wildlife refers to all species of animals which are not domesticated, including aquatic animals, both fresh water and marine. Traditionally, wildlife has referred almost exclusively to game animals but there has been more emphasis recently on the ecological and aesthetic importance of nongame wildlife.

Wildlife is only one component of a complex interacting web of plants and animals. The interrelationships between organisms and their environments form the framework of ecosystems through which forms of life are sustained and the environment is continually renewed. The type of ecosystem which each wildlife species requires to survive is referred to as its habitat.

Most forms of wildlife require a specific type of habitat in order to survive. Because of the close linkage between species and their habitats, a major responsibility of this department is to identify these habitats and work to preserve areas for the species to survive in adequate numbers. Fish and wildlife serve several purposes. Many species provide recreation for anglers and hunters. Others are nongame fish and animals, and in addition to serving a function within their habitat, they contribute to the general gene pool.

Long-Term Planning Needs

Spawning and nursery areas for salmon and steelhead need to be cleared and spawning populations need to be increased.

Species of fish which migrate to the ocean to mature but must return to their fresh water origins to spawn are known as anadromous fish. Usually the

spawning grounds are in streams and rivers, many of which are scores of miles upstream in the foothills and mountains. Among the anadromous species are salmon and migratory rainbow trout known as steelhead.

King (Chinook) salmon and silver (Coho) salmon are the only salmon that enter California rivers in significant numbers to spawn. Since the turn of the cnetury, salmon and steelhead populations have declined approximately 60 percent. Salmon, which annually support a $57 million recreational and commercial industry, produced a catch of 885,000 fish in 1978. The steelhead sport catch approached 122,000.

The Klamath River system, largest of the coastal California rivers, currently supports approximately 66 percent of the king salmon and 15 percent of the silver salmon that spawn in California's coastal rivers. The 3600 square mile Eel River system is the second largest coastal river spawning area. However, the numbers of salmon passing the Benbow Dam Fishway on the Eel River in Humboldt County have declined dramatically since counting was begun. The most recent counts indicate that the king salmon runs are relatively stable but the silver salmon runs are continuing to decline.

The Sacramento/San Joaquin Valley river systems support the remainder of the salmon and steelhead resource in the state. King salmon are the only salmon of any importance in this system. There are four major runs each year—fall, late fall, winter, and spring.

Several problems related to the damming of California rivers have adversely affected the salmon population. For example, gravel deposits which are essential to the protection of eggs and young fish have been lost through sedimentation and erosion. Replacement gravel that normally is transported downstream from upriver areas is now held behind the dams. Heavy metal contamination from mining operations and changes in stream flow patterns are other factors related to dams. Predators and water diversions, limited nursery areas, and other hazards, also affect the survival rate of young fish between hatching and reaching the ocean. In addition. large numbers of salmon are caught from the ocean by commercial and sport fishermen.

The present status of wetlands and modified wetlands needs to be stabilized and additional wetlands need to be acquired or preserved through incentives to private owners.

Of the approximately five million acres of wetlands which existed prior to European settlements, 91 percent have been lost. Coastal marshes have fared slightly better than inland marshes with about a 75 percent loss. Up to 94 percent of the freshwater wetlands of the Central Valley have been destroyed. Most wetland losses result from reclamation and water development projects related to agriculture, urban sprawl, and road construction.

Wetlands include a broad array of areas where land, water, and vegetation interact. They are generally inundated by enough surface or ground water to support vegetative or aquatic life that require saturated conditions for growth and reproduction. Some wetlands, such as vernal pools, can be saturated during the winter and dry out during the summer.

Wetlands are known for their value as habitats for wildlife. At least 50 fur and game species in the United States, exclusive of waterfowl, inhabit wetlands to obtain food, water, or protective cover. Wetlands are also essential to many aquatic species, both fresh water and marine, as breeding grounds and as nursery areas for the young until they are large enough to move into deeper waters.

However, the essential value of wetlands is their contribution to the natural food cycle and their great biological productivity which is sometimes said to be nearly ten times that of terrestrial land on a per acre basis. In these settings, dead plant matter and dissolved nutrients such as phosphates, nitrates, and ammonia act as the basic building blocks of the ecological food chain. Rich plant and invertebrate life flourish and they, in turn, support the fish populations as well as the feeding needs of birds and sometimes mammals.

Wetlands also serve a function of filtering pollutants and renewing water supplies, although this benefit can be lessened by overloads. Marshes, estuaries, and other types of wetlands are capable of removing inorganic nutrients, such as sewage phosphates and nitrates, and recycling them into the food chain, an expensive process when carried out in artificial systems created by humans.

Wetlands also filter stream flow sediments which settle in the bottom of the wetland and eventually bring about its demise through infilling. If natural processes are not interrupted by man's activities, in time every marsh becomes a wet meadow or upland, although the process, as it proceeds

naturally, can take thousands of years. As the watersheds around wetlands are stripped through timbering, development, and other activities, the delicate water-soil-vegetative balance can soon be overcome. The sedimentation rate is accelerated, water circulation is reduced, and stagnation and eutrophication tend to kill off the natural inhabitants and create breeding grounds for mosquitoes.

The Central Valley wetlands are particularly important as a stopping point and terminus for the Pacific Flyway which covers the western portion of the North American continent and portions of the Artic and eastern Asia. Most waterfowl using this flyway are hatched in the praries of western Canada and the river valleys and deltas of Alaska. Most of these birds winter from Washington to Mexico for about 60 percent of the flyway's total population. Approximately 10 to 12 million ducks and geese, accompanied by hundreds of thousands of shorebirds and other water-related birds, annually winter or pass through the Central Valley.

Key habitats need to be acquired, restored, and maintained for more than 900 species of fish and wildlife in California, including 212 presently identified species of rare, endangered, or threatened plants and animals.

Our understanding of the environment and the complex web of relationships that are essential to its successful functioning is still largely a mystery. The delicate balances which are characteristic of a single ecosystem fan out in every direction into the creation of increasingly complex balances with other living and nonliving organisms that are parts of other ecosystems until the entire planet can be seen as one ecosystem. The central and profound question faced by every expert in resource management is to discover where to enter into the solution of an environmental problem. This is the question faced by fish and wildlife managers in determining the choice of habitats that will generally enhance the welfare of our entire wildlife populations and, at the same time, enhance the quality of life for the inhabitants of our state, nation, and world. For this reason, probably the best approach to understanding the needs for habitats that can accommodate and nurture as many species of wildlife as possible is to describe the research and the types of knowledge about our environment, its inhabitants, and mutually shared habitats that we will have to develop within the near future. Listed below are a number of research topics that need to be studied along with the ongoing acquisition, restoration, and maintenance of habitats.

- Learn how judicious management can be applied to achieve harmony between the needs of wildlife and other uses, such as road construction, timber harvesting, and land use for recreation.
- Determine the ideal habitat conditions for various species of wildlife in different locations and at different points in their life cycles.
- Determine instream flow needs of fish populations on a stream-by-stream basis.
- Develop a marine nearshore habitat-type inventory, cataloging the habitat types in the nearshore marine ecosystems so that changes in the ecosystem can be evaluated and specific effects determined.
- Learn how the habitat requirements for wildlife species may conflict with other uses, such as the use of forest forage by domestic animals as well as wildlife.
- Identify the effects of bird populations on controlling insects which damage valuable timber species.
- Appraise damages to forest vegetation caused by wildlife species and determine acceptable control methodology.
- Study the effects of timber harvesting on livestock grazing on food and cover for different species of wildlife.
- Identify the characteristics of prime-fish habitats and determine the effects of land and water management.

Department of Forestry
1416 Ninth Street
Sacramento, CA 95818

The Resource

The Department of Forestry, located within the Resources Agency, and operating under the policies of the State Board of Forestry and Public Resources Code, is responsible for providing fire protection and watershed management services for the protection of private lands and state-owned lands in California, outside of the incorporated cities.

California includes a total land area of 100,191,000 acres. It is the third largest state in the country in terms of land area. About 33 percent or 32,558,000 acres are classified as forest areas. However, only about 16 percent of the total land area of the state is considered as commercial forest lands. These are forest lands that are suitable for growing and harvesting timber in a continuous cycle. The total resources managed by this agency include about 33 million acres of timber lands, range lands, and wildlife and fish habitats. Any public area with about 10 percent of forest cover is considered to be forested whether it is used for recreation, range grazing, or other purposes.

There are two major forest regions in the state. One is an intermittent strip stretching 450 miles along the coast from Monterey to the Oregon border with a maximum width of 40 miles in some places. This is the habitat of the California redwood along with other important commercial tree species such as the Douglas fir and white fir. The world's tallest tree, a 367-foot coast redwood, is located in this area in the Redwood National Park. The second major forest area is a pine region that extends the full length of the Sierra Nevada and along the inner mountain ranges from Oregon southward to just north of San Francisco Bay. The principal species in this region are ponderosa, jeffrey, white fir, red fir, and some hardwood species.

California ranks second in lumber production in the country; 35 to 40 percent of the timber harvested comes from the national forests. The balance comes from privately owned tree farms. Californians also consume more products based on wood processing than any other state in the nation. These products include labels, printing papers, newsprint, packages, furniture, and charcoal briquettes. As our technology increases, the processing of wood-based chemicals is becoming a new and important industry with widespread applicability. One example of a wood-based chemical is torula yeast, a high protein product made from wood sugars spent in the pulping process. One variety, Type S, is used in baby foods, cereals, baked goods, and beverages. Type F is used in feed supplements for commercial domestic animals. Still another variety, Type FP, is used in pet foods. Other wood products, such as ethyl cellulose and similar chemical-based celluloses, are used in making a variety of products including football helmets, photographic films, medicines, fertilizers, and cosmetics.

Forests also provide us with another resource that we are just beginning to recognize. That is clean air. Through transpiration, the forest gives up moisture and oxygen to renew the earth's atmosphere. The present climate of the earth is partially determined by the size and location of forest lands on the planet. The effects of forestation on climate are immediately noticeable in urban areas where natural growth serves a variety of functions.

The forests also provide the habitats which are indispensable to the maintenance of living organisms of all types. Many species of birds and other wildlife animals depend on various stages of forest succession for their habitats. Even the anadromous fish such as salmon and steelhead that spawn in California rivers depend on a forested watershed for the water supply that makes possible their annual journeys up the streams and rivers. Domestic animals that graze on the rangelands under management by this agency are a source of food and other materials which are important for the maintenance of our lifestyles.

Long-Term Planning Needs

Growth and harvest of timberlands needs to be managed to assure a consistent yield and continuing renewal of forest resources.

Timber production in California has steadily declined for the past two decades. This is due partially to the withdrawal of commercial timberlands for other uses such as parks and wildernesses, as well as commercial development. The Forest Service classified 7.6 million acres of privately owned land in the state as commercial forest land. Information available about the condition of these lands is spotty and the annual yields vary widely.

The most dependable source for timber production is approximately 2.7 million acres of commercial forest land owned by companies with forest product mills. An additional 1.5 million acres are owned by companies that regularly supply the mills. These companies manage their lands on a continuous yield basis. The total acreage in these ownerships is increasing and the number and size of these holdings has been changing generally toward fewer and larger companies.

At present about 35 percent of the harvested timber comes from the national forests and the remainder comes from privately owned tree farms. Continued conversion of private commercial forest land to nonforest use if

decreasing the productive capacity of the state to provide the needed timber. However, under recent legislation, counties can designate land as Timberland Preserve Zones (TPZ) which can be used only for production of forest products. Tax allowances are also granted which make the investment profitable. By 1978, 75 percent of the private commercial forest land was in TPZs.

The old growth inventories are continuously being reduced and replaced by young growth through commerical harvesting and reforestation. Replanting is making the California forests more ecologically diverse than ever before. However, the overall quality of timber is reduced as the young growth increases and the old growth decreases. Parks, wilderness areas, and other preserves are becoming the last refuge for old growth.

Reforestation of 1.4 million acres of timberland, mainly in private ownership, is an important need for the immediate restoration of the productive capacity of the commercial timberlands. State cost-sharing plans are in operation to encourage the reforestation of privately held lands. Vegetation management programs also are being implemented in young timber stands to increase forage production, water yields, wildlife habitat, survival of seedlings, and growth rates. Through vegetation management, damages from fires and soil erosion are expected to be diminished or averted.

Massive urban reforestation is needed to improve the quality of life in these areas.

When the 1978 legislature passed the Governor's Urban Forestry Program, it began a new era for the California Department of Forestry. Ninety-four percent of the population of California lives on two and one-half percent of the land. Many of these areas are currently losing trees faster than they are replaced through insects, diseases, old age, vandalism, and urban development.

Forestation in urban areas offers many advantages for improving the physical and visual impact of the environment. For example, carefully placed trees can shield a building from the sun's direct rays during the summer more than during the winter. Shrubs can also shield walls from direct heat of the sun. Vegetation cools the environment during hot weather by reflecting much of the sun's rays, unlike concrete that absorbs the heat all day and radiates it at night to raise the ground temperature.

Trees also create breezes by attracting warm group air up as coolness is created by transpiration through leaves. Equally important is the aesthetic impact trees, shrubs, and other plantings have on the appearance of our environment and our mental well-being. They also provide an urban habitat for animals such as song birds and, in some areas, ground animals such as squirrels. Urban forestation also reduces noise pollution.

Several aspects of urban forestry are currently under study as part of a nationwide project sponsored through the Federal Forestry Service. One task is to select trees and other plantings that require minimal supplies for the semi-arid urban environments that characterize California. In some areas, deciduous trees that lose their foilage during the winter are most desirable for use in energy conservation. During the summer, they provide shade protection from the heating effects of the sun's rays. However, during the winter the sun's less powerful rays can permeate the bare limbs and provide heat. Another thrust is to develop resources and values that will cause people to participate in urban reforestation programs. Already, in many parts of the state, groups are working to recruit volunteers for major replanting projects.

Urban reforestation, to be sustained over years, will depend on cheap and readily available supplies of seedlings and young trees for replanting. This will require the establishment of urban greenhouses and other urban sources for the acquisition of all types of planting. Because of the newness of the program, these facilities are still in the planning stages with consideration for such factors as optimal locations for creating urban employment and the variety of plants and trees that would be most desirable for a particular urban location.

Forest fires are a major threat to the depletion of our forest resources, the loss of wildlife, and the destruction of built environments.

California leads the nation in its unique wildland fire problems. The historic approach of adding more expensive and sophisticated fire suppression forces can no longer be maintained. It is not only too costly but the end effects of relying on this approach exclusively are less productive than other methods.

One approach that holds promise for reducing the threats of fires is to reduce the fuel loading of old growth within the forest and on chaparral lands. This requires regular and controlled burning off of the undergrowth

in the forest and on the open chaparral lands. By purposely burning off the shrub undergrowth before it becomes too thick, fire temperatures can be kept within the range that will not be damaging to the established tree growths. However, by allowing the undergrowth to build, when fires are started, the heat becomes intense enough to destroy all plant life including the trees. Burning off the chaparral areas, allows for the gorwth of grasses and other plants less dangerous in terms of being fire hazards. Interestingly, it has been established that wildlife populations prefer forested areas in which the undergrowth is kept down. Thickly forested areas with excessive amounts of underbrush are generally avoided by wildlife populations. Hence, this resource management technique also benefits preservation and growth of wildlife in the forested areas.

Research needs to be conducted and methods developed for the use of residues from timbering and waste materials from forest clearance as an energy source.

There is a long list of benefits that could occur from the systematic harvesting of wood residues for energy production. For example, wood is a renewable, biodegradable, and naturally stored fuel. Clearing forests of the undergrowth that creates devasting forest fires not only ameliorates that problem, but also decreases the need for hazard reduction burning. Clearing forests of logging residues for the production of energy is an added stimulus for improved silva-cultural practices which can offset some forest improvement costs.

Wood conversion technologies are relatively simple and potentially more reliable than technologies using coal and oil. This source of energy can be refined and packaged in rural areas, providing employment and self-sufficiency for these areas. It is also a potential source of income to landowners who can clear their own lands and sell the waste materials to a local wood conversion operation.

Several avenues for the eventual use of this resource are currently being explored. For example, one project explores the use of hardwood-encroached lands. The hardwood timber is used for energy production as the lands are replanted with softwoods, more useful in commercial timber production. Other studies are being conducted on the economic feasibilities of using wood as an energy source. One project conducted jointly by the California Energy Commission and the Department of Forestry is demonstrating the technical and economic feasibility of using a gasifier/engine generator system to supply electrical requirements for a conservation camp operated by the Department of Forestry. Eventually, a step-by-step procedure for establishing similar systems throughout the country will be produced.

Studies are also being conducted on the effects of the clearing of logging residue and underbrush on the nutrient cycles in different areas. At present, these studies show no adverse effects. Urban parks, such as the Golden Gate Park in San Francisco, generate large volumes of wood residues from maintenance and replacement activities. The Golden Gate staff, in collaboration with the Department of Forestry, has developed a program to use the residues, providing an alternative to conventional heating fuel sources and mitigating the problems of residue disposal.

Department of Parks and Recreation
1416 Ninth Street
Sacramento, CA 95814

The Resource

About six million acres of California's mountains, deserts, and coast are managed for park and recreation purposes by various federal, state, and local agencies. The California Department of Parks and Recreation, as part of its overall responsibility for statewide planning and policy in the park and recreation field, manages about one million of these acres within the California State Park System. This includes some 250 state parks, beaches, wildernesses, natural preserves, historic sites, and recreational areas throughout California.

The State Park System accommodates more than 60 million days of visitor use each year in camping, picnicking, fishing, boating, sightseeing, and a hundred other activities, including many kinds of environmental learning experiences.

Everyone thinks of parks as places for recreation where you can hike, swim, picnic, or play baseball. One of their important purposes is to provide a

release from physical tensions, a health-building experience. They also serve as a unique setting for understanding our history and our cultural heritage. But most importantly, they are places where men and women may come to discover, understand, and appreciate the interrelationships and interdependencies between people and their environment. They are a means of making us aware of the world around us. They provide a chance to see that world as it is naturally, not as modified by other human beings. They expand our sense of values beyond the merely economic. They provide an opportunity for contemplation, reverie, solitude, and peace. They are "islands of hope."

Long-Term Planning Needs

Increasing public demand needs to be met, while sustaining the high quality park experience.

Park use continues to increase at an even faster rate than the state's population. Thousands are turned away at popular parks and recreation areas during peak vacation periods. Existing facilities are strained, sometimes even to the detriment of the resource itself as when deeply rutted trails erode a meadow, or constant use of a campground compacts the soil and suffocates redwood roots.

Lands that are suitable and available for park use are not unlimited, and competition for land of any kind is becoming increasingly intense. Costs for both acquisition and development continue to rise. Funding to operate and maintain existing facilities becomes more difficult to obtain. Comprehensive long-range planning is essential to meet human needs while preserving the environmental quality on which all else depends.

More urban parks need to be developed and many that exist need to be upgraded.

Ninety-four percent of California's citizens live in urban and suburban areas on two percent of the land. Urban parks and recreation areas are essential in many ways to the preservation of our health as a society. Often, they provide the only open space for relaxation and recreation in congested areas. Urban parks with natural growth such as trees and bushes reduce pollution, reduce noise, alleviate temperature extremes, reduce energy consumption, provide soil and watershed protection, improve urban wildlife habitat, and beautify neighborhoods. They also often serve as the only continuing contact which people have with the natural environment, and provide an aesthetic quality that exists nowhere else in an urban area. The importance of urban parks is now being recognized, and they can be expected to receive increasing attention in the years ahead.

Parks and their programs need to serve a broader population, particularly minorities, the disabled, and the elderly.

Many of those who most need the benefits parks can provide are unable or disinclined to use them. A major effort in park systems at all levels is to make park and recreation facilities more accessible to the disabled, to develop programs that will more effectively serve minorities, the elderly, and other populations with special needs.

There is a need for greater public involvement in planning parks and in operating them.

Public involvement is being increasingly recognized as the foundation for good planning. People need to participate in all stages of the planning process so it can be responsive to their needs. And they are needed more than ever when the plans come to fruition; many park programs would not exist without the help of dedicated volunteers. Parks need people as much as people need parks.

New strategies must be found to help parks become more self-sufficient economically.

Park values should not be measured solely in terms of economics, but neither can economics be ignored. Parks must compete for public dollars, and the more nearly they can become self-supporting, or find ways to offset some of their costs, the better they may be able to afford some of the things that do give parks their highest value.

There needs to be a new look at how people get to parks.

In spite of people's reluctance to abandon their cars, transportation patterns may be changing. It's becoming less and less feasible to travel halfway across the country to go through 20 parks in as many days. The cost-conscious are staying closer to home and remaining longer in one place. Interest in public transportation is reviving. Park planners, hopeful that the

day of giant parking lots is passing, feel whole new concepts may be necessary.

How to use parks in environmental education

You don't have to go to Pt. Lobos to learn about the natural environment. A patch of weeds at an asphalt playground will illustrate most environmental principles. But, because these great places **are** outstanding, they command attention. A trip to the redwoods or the desert makes a lasting impression that no child can forget. A wilderness experience can only be had in a wilderness.

Learning about how people lived in an historic period can give perspective on how we live today, on the choices we make about how we use our environment. And there is a profound difference between actually going to a place and just reading about it. That's not to say you should overlook the park next door, either. It, too, can offer a variety of habitats, of plants and animals—and, all too often, a drastic contrast with its surroundings—that can be used in a lot of teaching ways.

The California Department of Parks and Recreation has environmental living programs at several of its units, where classes can stay overnight and "re-live" the life of an historic period. But these programs can only handle a relatively small number of classes and are usually booked far in advance. Some parks have shorter, daytime programs of a similar nature. Efforts are being made to mesh the park system's offerings with this new statewide environmental education curriculum, and most parks have at least some informational materials on the resources they have available. At the very least, there is almost always a ranger with whom you can discuss your needs.

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Department of Water Resources
1416 Ninth Street
Sacramento, CA 95814

The Resource

The Department of Water Resources provides leadership for the management of California's water resources. The Department's programs are designed to implement a California constitutional requirement that the state's water be put to the fullest possible beneficial use, and that waste and unreasonable use of water be prevented.

Water, seemingly, is everywhere. It covers three-fourths of the world's surface as a liquid. It is also present in the atmosphere in a gaseous state and large amounts exist in a solid state as the polar ice caps. The water in the oceans and the ice at the polar caps comprise 99.3 percent of the water on the planet. The remaining 0.7 percent, at any one time, exists in the atmosphere, lakes, rivers, soil, and subsurface deposits. Water is the primary constituent of all animal and vegetable matter and the processes of life depend on a constant interchange of water between living matter and the environment.

California has 12 hydrologic basins into which water from precipitation flows. The total annual supply of water in California is estimated to be 31.3 million acre feet, although average annual precipitation amounts to about 200 million acre feet. (An acre foot equals approximately 326,000 gallons.) The difference between precipitation and availability is lost for human use through evaporation from the surface of vegetation, ground, and water, through transpiration from vegetation, and through runoff to the oceans.

The runoff from precipitation in these twelve basins is one major source of the water we use. Most of the state's runoff occurs in the north coast and the

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Sacramento basins. This is also where the two major forest areas in the state are located, one running down the coast from Oregon and the other following the mountain ranges to the east of the valley from Oregon to the San Francisco Bay Area. In terms of both water supply and water quality, the condition of the flora in the upper regions of a runoff basin is critical. The high, steep portions of the basin usually receive the largest proportion of the rainfall and the vegetation on these slopes, if it is thick, prevents the erosion of soil, allows the runoff, and enhances absorption of the water into the soil, ensuring a well-regulated runoff flow and good quality water.

The second major source of water supplies is the underground deposits called aquifers. These are natural reservoirs which water seeps into and is stored. Aquifers develop very slowly over long periods of time that can range to thousands of years.

A quick survey of the figures for average annual runoff in each of the basins reveals that there is an uneven distribution of rainfall and the need for water in California. The largest population centers are in the south were the least amount of rainfall occurs and the water reserves are the smallest. Similarly, the San Joaquin and Tulare Lake basins are the sites of a large percentage of the most productive farmlands in the state. Water management practices, traditionally, have developed storage and transport systems—dams, reservoirs, canals, and aqueducts—that can ensure a constant supply of water from the high rainfall areas to where it is needed.

Human needs for drinking water are far less than needs for washing, flushing toilets, and other ways in which water is consumed in daily living. Industrial needs consume considerably more water in manufacturing processes and in generating power than humans do in daily living. Agriculture, however, is the single most water-consuming activity in the world. In California, agriculture uses 85 percent of the total amount of water consumed in the state. Most of this is lost through transpiration as crops mature and through evaporation as the land is irrigated. Following are estimates of some water requirements:

USE	AMOUNTS REQUIRED	
	Liters	Gallons
Drinking water (adult daily)	1	0.26
Toilet (one flush)	20	5.28
Clothes washer (one load)	170	44.88
Refine a ton of petroleum	2,000 - 50,000	528 - 13,200
Produce a ton of steel	6,000 - 270,000	1,584 - 71,280
Grow a ton of wheat	300,000 - 500,000	79,200 - 132,000
Grow a ton of rice	1,500,000 - 2,000,000	396,000 - 528,000
Produce a ton of milk	10,000,000	264,000
Produce a ton of beef	20,000,000 - 50,000,000	528,000 - 1,320,000

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Long-Term Planning Needs

Present overdrafting of groundwater supplies is threatening the availability of a continuously dependable supply of water in the future.

Groundwater is stored in aquifers which are natural underground reservoirs in porous rock below the soil surface. The location of aquifers is dependent on the permeability of the soil and rock layers in an area. Groundwater, obtained through drilling wells, is the cheapest and most accessible alternative to surface water supplies. When groundwater is withdrawn at a rate greater than the recharge rate, the water table drops, increasing the depth to which wells must be dirlled. Since drilling costs increase rapidly with depth, withdrawing the groundwater can become uneconomical. In these cases, aquifers can be thought of as a nonrenewable resource that has been mined out. Often, not only the groundwater resource is lost. Surface streamflows can be severly reduced with the lowering of the water table and ecologically important wetlands can dry up. In coastal areas, depletion of freshwater aquifers can lead to the intrusion of saltwater, and, again, permanent loss of the resource.

Groundwater supplies have been permanently depleted in parts of Arizona and in the high plains of Texas where water tables have fallen up to 30 meters. The principle overdraft area in California is the San Joaquin Valley where the safe yield of groundwater is exceeded by 1.7 million acre feet each year. Without other supplies of water, a region can suffer a serious decline economically and in other related ways. Moreover, the decline in groundwater supplies also threatens the maintenance of a dependable supply of water in dry years and can also cause economic decline because of periodic droughts. In some areas, development moratoriums have already been declared because of serious declines in the water table.

There are two basic approaches to dealing with the problem of overdrafting groundwater. One approach is to develop a comprehensive statutory system of groundwater law. This requires the establishment of groundwater management areas based on the survey of geological conditions and the identification of major groundwater basins.

The other approach is to recharge the aquifers during wet years using technology that will allow for quick absorption of the water by the porous rock. Aquifers, in one way, are very preferable to surface reservoirs because of the evaporation problem which can be particularly severe in hot, dry areas. For example, losses through evaporation at Lake Mead have been measured at one cubic kilometer per year or about 4,500 liters (1,190 gallons) for each person in the United States.

Waterlogging and salt accumulation on irrigated lands is threatening agriculture production.

Waterlogging, salinization, and alkalinization commonly occur when irrigation systems, particularly in arid lands, don't allow for proper drainage. As the water flows through the soil, salts and other solid deposits are filtered out and these accumulate. The San Joaquin Valley is the region most seriously affected by this problem. About 400,000 acres at present have high brackish water tables that pose a threat to the productivity of the land. When the water table reaches the root zone productivity is sharply curtailed. It is estimated that 700,000 to one million acres will seriously be affected by this problem by the year 2000. Lost crop production could reach $320 million annually by the year 2000. One approach to this problem is to install subsurface drainage systems for individual fields and a master drain for a large area. This can be very expensive both initially and in the maintenance of the system to assure continued adequate drainage.

A more economical approach is to grow more salt tolerant crops such as barley, cotton, and sugar beets. Studies are being conducted to test the effects of brackish water on these types of crops.

A third approach is to build desalting plants. So far, however, the desalting process has been very expensive. In 1975 there were about 700 desalting plants in the world but almost none were used in agriculture. Larger plants averaged a cost of around 15 cents per cubic meter and smaller ones ranged from 25 to 50 cents. This price excludes use for all but very high-value crops such as tomatoes, avocados, and orchards. Experimental plants are in the design stages using biomass conversion, solar pond power generation, and recovery turbines in conjunction with ponds and marshes in an attempt to reduce the cost of the desalted water.

Widespread water conservation practices can reduce the need for developing new water supplies in the future to meet the needs of an increasing population and industrial growth.

The most economical and environmentally safe way of increasing the real

supplies of water is to conserve through reduced consumption, using the existing supplies more efficiently. However, probably because of the widespread presence of water and its importance for our existence, it has not often been thought of as have other natural resources such as petroleum, minerals, and coal. As a consequence, the methods for water management and use have been quite different from those methods used for the other natural resources. For example, water has historically been very cheap regardless of the supply, and even in areas or times of shortage it has been put to low-value uses such as watering lawns or filling swimming pools with no regard for the consequences to higher-value uses. Water consumption has been accepted almost as a personal right. Instead of placing limitations on its use and practicing conservation, emphasis has been placed on transferring supplies from one water basin to another which sometimes has had disasterous environmental consequences.

In fact, a substantial part of municipal water use in the United States is the result of leaks, including running toilets, and dripping faucets as well as letting a tap run unnecessarily. Retrofit devices have been used effectively to reduce consumption. For example, 35 major urban areas throughout the state showed a 21 percent reduction in water use in 1977 compared to 1976. Water conservation has persisted to the present time and is still 17 percent less than in 1976.

Industrial uses also account for much of the wasted water. A good proportion of quantities required by industrial processes can be recirculated instead of being permanently withdrawn from existing reserves.

Irrigation, the prime consumer of water in California, can be managed more efficiently from the standpoint of water consumption. For example, high frequency irrigation, using smaller amounts at more frequent intervals and through pipes, has the potential for saving considerable amounts of water. The use of computers in this operation has the potential for further increasing conservation effectiveness. As mentioned above, planting crops that are more tolerant of the salt content of water is another way in which agriculture can increase its efficient use of water.

Probably the most effective means for conserving in the consumption of water will be found in adjusting prices to reflect the scarcity of this resource in a particular region. Heretofore, society has subsidized people living in arid regions by making the cost of water artifically low. Through pricing practices that reflect the actual scarcity of the commodity and adjustments to prevent the demise of industries such as agriculture, it is hoped that water management practices will be brought more in line with the economic laws that govern scarcities of the other natural resources.

Water distribution systems need to be further developed to meet the expected needs for water by the year 2000.

Projections place the demand for dependable supplies of water in California at 4 million acre feet annually by the year 2000. With effective conservation programs, this figure can be reduced to 3.4 million acre feet per year. As noted above, the major areas for water supply are in the north and the areas of greatest need are in the San Joaquin Valley and the coastal areas in the south. The source with the greatest potential for supplying water is the Delta region in the Central Valley. It is here that the flows from the Sierra Nevada, cascading down the western slopes in a myriad of streams, converge in the Central Valley to form the greatest river system within the boundaries of a single state in our country.

Some of the problems related to using this area as a major source of supply for other parts of the state are political and some are environmental. Often, in the past, water has had a peculiar local nature that is not attached to other natural resources. Some areas can enjoy an abundance while adjacent areas suffer from a scarcity. People and industries upstream can pollute water through a variety of ways such as the runoff from fertilizing practices without regard for the consequences to people's needs further downstream. In other cases, upstream areas can siphon off most of the water supplies for activities such as irrigation and leave inadequate amounts for those areas closer to the mouth of the river or stream.

The use of water from the Colorado River is a case that illustrates both of these points. Originally, Mexico was not included in the water sharing agreement and, as a result, very little flow was left by the time the Colorado River reached that area. Salinization from irrigation later became a problem when it reached such high proportions that the water, once it crossed the Mexican border, was virtually useless. Fortunately, both of these problems have been settled in an amicable way.

The political power manifested in the sheer numbers of people in the southern coastal region has been perceived, in some instances, as the only

reason why water diversification projects are being planned. Extreme sentiments against these plans in the northern areas have led to abortive threats to take actions such as seceding from the state.

There is also the fact that plans to divert large amounts of water from the Delta to the southern areas will produce negative environmental effects in the north such as the influx of saltwater through the San Francisco Bay and the Carquinez Straits. Others say that controlled releases of water to the Delta would protect the San Francisco Bay-Delta Estuary and the Suisun marsh while also providing good quality water for transport to the southern part of the state.

The controversy surrounding the movement of great amounts of water from one basin to another is being experienced in other parts of the world such as in the controversy that erupted between India and Bangladesh when the former drained much of the water out of the Ganges River to flush out the Calcutta Harbor and seriously depleted the supplies needed for irrigation by its neighbors.

All of these problems are, in turn, an indication that people and nations all over the earth are becoming more aware of water as a limited natural resource. As demands on the available water increase, this resource is being viewed more as other natural resources are and is being subjected to the same economic laws that regulate their use.

State Lands Commission
1807 - 13th Street
Sacramento, CA 95814

The Resource

The State Lands Commission acts as the manager for about 4.5 million acres of land held in trust for the people of California. One portion of these holdings, about 4 million acres, was acquired as sovereign lands when California joined the Union in 1850. Approximately the size of Conneticut and Delaware combined, these lands include the beds underlying about 30 navigable rivers throughout the state such as the Klamath and Sacramento, the basins of almost 30 navigable lakes such as Lake Tahoe and Clear Lake, and the three-mile-wide strip of tide and submerged land adjacent to the coast and offshore islands.

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The other portion of these lands, about 610,000 acres, is the remainder of a federal grant made to California shortly after statehood to support public education. In that grant, the state was given two square miles out of each 36 square miles held by the federal government. Originally, that amounted to about five million acres, most of which was quickly sold to private holders. The remaining portion, no longer subject to sale, is currently being consolidated through exchanges with other public land holders into larger blocks that are more economically useful.

The Commission is composed of two elected public officials, the State Controller and the Lieutenant Governor, and one cabinet level officer appointed by the Governor. This composition was determined in 1938 when the Commission was formed to assure that public interest in the use of these vast holdings would be safeguarded. Revenues from the original school lands are still used for support of the public school system.

Long-Term Planning Needs

Energy and resource development on the lands managed by the Commission needs to be promoted and guided by the procedures that will provide the most benefit for the citizens of California.

Oil and gas deposits on state lands, particularly in the tidelands and submerged offshore areas, are an important resource that is being developed through the collaboration of the public and private sectors. Average daily production of oil on state lands is approximately 100,000 barrels. Revenues for 1981-82 are estimated to be enough to enable the Commission to produce more revenue than any other nontax state agency. The Commission has successfully formulated firm procedures to avoid oil pollution accidents caused by wells on state-owned lands as evidenced by the fact that not one major incident has involved wells located on lands leased by the state. One reason for this successful record is that potential environmental impacts are rigorously assessed before any drilling operations are allowed.

The largest geothermal electric generating complex in the United States is located in Sonoma County at The Geysers. More than half of the steam used to generate electricity at this site comes from state geothermal leases. Over a half million acres of state-owned land are located in regions with geothermal potential although only a small portion of that area has been explored. The Commission's task is to promote full use of these resources

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while safeguarding environmental quality and maximizing economic benefits to the public.

Other resource development activities include timber harvesting and grazing leases on the remaining school lands. Additionally, although the state sold large portions of the original school lands grant, mineral rights were retained on 716,000 acres. Consequently, now the Commission leases some of its rights for mining operations and collects royalties for the production of sand, gravel, precious metals, iron, and other minerals.

General development of lands managed by the Commission needs to be promoted in a manner that safeguards public use of all navigable waters within the state.

Almost since California became a state, the legislature has granted tide and submerged lands in trust to cities and counties so that these regions could develop harbors and waterfronts in accordance with locally developed plans. In many places, these granted lands have been developed into marinas, harbors, aquatic parks, and other types of recreational areas. Although these lands are under local control, the Commission has responsibility for monitoring the sites to ensure compliance with the terms of the statutory grants. These grants, traditionally, have been designed to encourage the maximum development of tidelands in a manner that is consistent with the public's best interest while requiring the grantees to reinvest any revenues produced back into the lands where they are generated.

The Commission also has authority to issue permits for the dredging of harbors and waterways that have become obstructed with mud or silt. These permits are granted to both public and private parties. Other dredging initiated by the Commission is done to improve the configuration of the shoreline and to reclaim private and public lands.

The Commission also has responsibility for two public service projects. One project resulted from the 1977-78 drought. When waters receded as a consequence of the drought, a large number of hazardous objects such as pilings, discarded junk, and other large objects were discovered within the navigable waters in many areas. The Commission has been given responsibility for a massive undertaking to identify these hazards and remove them. Current efforts are being concentrated in the areas of Lake Tahoe and the Sacramento/San Joaquin Delta. These efforts also include the removal of abandoned oil drilling equipment in the tidelands and submerged areas.

The second project, to clarify water boundaries, is the result of more intensive use of waterfront lands. Because land was abundant and put to low density use until recently, many early land descriptions which involved water boundaries were vague and uncertain. Within the last 50 years the determination of these boundaries has become a problem of increasing proportions. Now, it is estimated that more than 7,000 miles of common water boundaries between public and private lands are in dispute. The Commission has relied on historical records, maps, minutes of public meetings, archives, and interviews with historians and local longtime residents as some of the sources for resolving these disputes. The resolution of these land title problems is important not only to protect the public's resources, but also to enable private parties to obtain sufficient title insurance.

State Solid Waste Management Board
1020 Ninth Street, Suite 300
Sacramento, CA 95814

The Resource

In 1972 the California State Legislature established the State Solid Waste Management Board to develop and maintain a state program of nonhazardous waste management and resource recovery which would protect public health and safety, promote economic productivity and environmental quality, and conserve natural resources.

Californians generate about 46 million tons of nonhazardous waste each year and pay approximately $600 million annually to have it disposed of in various ways. Presently, most solid waste is landfilled. However, landfill sites are becoming less available, and it is anticipated that only three-fourths of the present capacity for disposing of solid waste in this way will exist by the end of 1990. Unless other options for the disposal of solid waste can be developed by that time, California will be faced with a serious garbage crisis.

The Legislature acted in 1977 through SB 650, the Litter Control, Recycling and Resource Recovery Act, to give the State Solid Waste Management

Board responsibility to develop public awareness of the crisis, foster a new ethic toward waste disposal, and develop new systems to recover materials and energy from garbage. The board's management activities include state and local planning, enforcement of environmentally sound landfill practices, recycling, resource reuse and energy recovery, litter control, waste reduction, and public education.

Long-Term Planning Needs

Fortunately, there are alternative systems to landfill disposal of solid waste. However, each of the options has advantages and disadvantages that need to be taken into consideration when developing a long-term plan for solid waste management. The following assessments describe alternative methods for dealing with the growing waste generated by our society.

METHOD: Waste Reduction

Waste can be prevented at its source by altering manufacturing processes, product and packaging design, patterns of consumption and waste generation to conserve natural resources and energy, and to extend product lifetime. Examples include purchasing products with minimal packaging, manufacturing more durable and fuel-efficient products, and reusing products rather than disposing of them.

	PRO	CON
ECONOMIC	Reduces municipal disposal costs. Reduces energy used in manufacture. More efficient use of natural resources. Can create new job opportunities.	Major capital investments for industry. Intrudes on free enterprise system. Loss of feedstock and revenues for resource recovery projects. Can create job dislocation.
ENVIRONMENTAL	Reduces litter and pollution. Preserves natural resources. Promotes efficient land use.	Sanitation problem from storage of reusable food containers.
TECHNOLOGICAL	Existing technology is used to create more durable products.	Additional research needed to create more recyclable products. Product design technology is insufficient.
IMPLEMENTABILITY	Can be done by all sectors. Requires minimal initial effort by consumers.	Resistance to change in behavior by citizens, government, and industry. Lack of external incentives discourages participation. Conflicting data impedes decision making. Inadequate public awareness.

CONCLUSION

Waste reduction is the initial and most important alternative to solid waste disposal. However, it is a highly complex and controversial issue because it is intertwined with philosophical considerations regarding the role of government; the functioning of the free market; the relative value of social, economic, and environmental factors; and concepts regarding the quality of life as measured by the consumption of material goods.

METHOD: Landfill

Landfills are now the final repository for most solid wastes. The wastes are unloaded, compacted so as to reduce the volume, and covered with soil.

	PRO	CON
ECONOMIC	Inexpensive alternative (approximately $3-5 per ton). In some cases, energy recovery from landfill-produced methane gas may be economical.	Landfill costs are expected to increase because of increased haul distances and compliance with environmental standards. Capital costs for land close to waste sources is increasing due to urban development.
ENVIRONMENTAL	Previously unusable land (e.g., gravel pits) have been reclaimed for some social use.	Use alternatives for usable land are limited. Poor operations may result in odors, propagation of disease vectors such as flies, groundwater pollution, and/or migration of explosive gases. Most landfills will be energy consumptive. Energy and material resources in the wastes are lost. Even with gas-recovery energy resources are not fully used.
TECHNOLOGICAL	No new technology is required for existing practices in landfill operation.	Environmental monitoring, control, and cleanup techniques for odors, gas migration, and groundwater pollution are not well developed.
IMPLEMENTABILITY	Landfills are needed for residuals of any alternative.	Poor landfill operations create adverse public impressions, creating barriers to obtaining land-use permits.

CONCLUSION

Landfill is perceived by the public to be less desirable than resource recovery and common belief is that landfills are obsolete, unneeded, unacceptable, and a waste of resources. Its economic advantages will rapidly diminish with increased haul costs. The requirements for new landfill will not disappear but will be diminished by implementation of resource recovery.

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METHOD: Composting

Organic wastes (paper, leaves, food, etc.) can be converted into humus-like compost through aerobic (with air) bacterial decomposition.

PRO	CON
ECONOMIC Small scale composting is not capital intensive.	Large scale composting is capital intensive. The commercial compost market is very limited and is currently being served with compost made from other wastes (sewage, sludge, manures, wood bark, etc.).
ENVIRONMENTAL Represents a closed loop ecological cycle whereby substances grown from the land are ultimately returned to the land for recycling. Improves soil and increases productivity of humus-deficient soils. Reduces landfill space requirements by 60-70 percent.	Composting is energy consumptive; requires approximately 1.5 gallons fossil fuel per ton of compost or 1,500 BTU/lb. to process. Heavy metal impact on crops from sludges are under study. Odor, nuisance, rainfall runoff, and leachate must be controlled. Requires controlled operations to insure destruction of pathogens present in sludge.
TECHNOLOGICAL The composting technology is proven for conversion of organic material. Composting technology is not complex.	Removal of pieces of plastic and glass shards from waste is preferable to ensure quality of the finished compost.
IMPLEMENTABILITY Vegetative composting appears easy to implement on a local basis for local consumption.	Acceptance by farmers of refuse-derived compost is problematical. Repeat compost markets are limited; market and usage are not constant.

CONCLUSION

Composting has the potential of reducing landfill space requirements, yields a beneficial soil amendment, and is easily implementable; however, impediments in developing composting as a practical alternative exist in the level of control required to produce a safe quality product, lack of constant markets, and resistance to use of composts produced from municipal refuse.

METHOD: Source Separation
Waste materials to be recovered (metal, glass, paper, etc.) are separated at the point of generation (household, office, etc.) for collection.

	PRO	CON
ECONOMIC	Little or no processing required to produce marketable material. Permits use of systems for handling low volumes of materials at each collection point with a very high yield at the central collection depot.	Increased labor and collection equipment is required if participation exceeds 20 percent. Profits are very vulnerable to market fluctuations and (except for paper) to container legislation. Major profit taking occurs at the central collection depot.
ENVIRONMENTAL	Increased education of the public, reduced consumption of virgin materials, and reduction of energy required through use of recycled materials. Can reduce landfill requirements for municipal refuse by an estimated 20 percent maximum assuming 100 percent participation and 100 percent retrieval efficiency.	Collection at many separate sites increases energy consumption. Data available indicate that the participation required to significantly reduce landfill requirements will be very difficult to achieve and sustain.
TECHNOLOGICAL	No new technology required for single family or commercial pickup.	Multi-family residential technique still developing.
IMPLEMENTABILITY	Has been implemented commercially for many years on specific items such as corrugated paper. Can be implemented immediately in some localities. Can be implemented with little capital investment.	Large scale implementation has not been achieved. Data on costs and market impacts are unreliable. Volumes and revenue are vulnerable to changes in participant behavior.

CONCLUSION
Source separation increases public awareness of the solid waste problem and has the potential to reduce projected increases in waste generation and requirements for processing facilities. This is the only system theoretically capable of achieving a 25 percent reduction in landfilled waste in the near future, but only by participation that has not been achieved anywhere on a large scale.

METHOD: Mechanical Separation and Production of Refuse-Derived Fuel

The municipal waste stream has a significant glass, metal, and energy content. These wastes can be mechanically separated into usable or salable products through combinations of devices called "front-end" systems. Waste materials that have been shredded and air classified can be used in conversion processes to create energy, chemicals, or compost. These conversion processes are called "back-end" systems. A densified RDF (dRDF) that is more easily transported and stored can be produced through pelletizing or chemical modification but at additional expense.

	PRO	CON
ECONOMIC	The system can be customized for specific markets. Magnetic ferrous separation is economical in some areas.	Substantial operating costs are involved. Produces more contaminated materials than source separation, hence affecting market value. Usually more expensive than direct haul to presently available landfill.
ENVIRONMENTAL	Permits conversion or reclamation of up to 80 percent of the municipal waste stream. Shredding of wastes reduces landfill acreage and cover requirements by up to about 30 percent.	Requires mitigation measures to control air, noise, or water pollution at processing facilities. Disposal requirements for residual materials not well known.
TECHNOLOGICAL	Mechanical facilities can handle the large quantities of waste generated. Shredding and magnetic separation are fully developed operations.	Shredders require extensive servicing. RDF, unless densified, is difficult to store and handle. Densified RDF (pellets, dried and powdered) adds significant cost and has not been adequately tested for economic benefits in a large scale operation.
IMPLEMENTABILITY	Facility can be developed in stages as markets develop and as conversion processes are defined.	Runs risk of needing redesign as markets change.

CONCLUSION

Mechanical separation can remove some materials from the waste stream but valuable products still remain to be reclaimed. Materials removal and size reduction will make landfill operation easier. Production of RDF for use in existing facilities is the most economical alternative but currently has a very limited market. Introduction of coal-fired facilities or new facilities with ash-handling capabilities are needed to make the production of RDF an attractive alternative on a large scale.

METHOD: Direct Combustion

The energy in wastes may be recovered by directly firing all or part of the wastes independently or with fossil fuels (co-combustion). Raw refuse can be fired in boilers designed for that purpose. Refuse-Derived Fuel (RDF) produced by shredding and air classification can be burned in boilers with ash handling capabilities such as those fueled with coal or wood waste.

	PRO	CON
ECONOMIC	Minimal cost for energy conversion if existing boilers or cement kilns are available ($4-7 per ton net costs). Production of steam could have large potential market (yet to be documented).	Usage in California requires new or extensively modified boilers. Competes with low-cost coal if boiler has ash-handling capability. Steam quality is lower than optimum for electrical power generation.
ENVIRONMENTAL	Landfill requirement reduced 70-90 percent, depending on process. Energy recovered is greater than processing requirements. Could supplement use of increasingly scarce fossil fuels.	Air emissions are still under investigation but system may have more difficulty with air quality impact regulations than with emission standards. Best management of residues under development.
TECHNOLOGICAL	Well developed in Europe and being demonstrated in the United States. Many small sized systems have been installed in Eastern United States. Steam recovery equipment is similar to proven solid fuel fired boilers using wood waste and coal.	The ability to control air emissions in accordance with California standards is a problem that is expected to be controllable but probably at considerable expense. Use in cement kilns adequately demonstrated but site specific and expensive at best.
IMPLEMENTABILITY	Steam energy source welcomed by industry.	Air pollution regulations are constantly being tightened. Requires assured supplies of waste.

CONCLUSION

Direct combustion is attractive from an economical point of view. However, severe implementation problems exist due to environmental pollution controls. Further evaluation is required in terms of capital and operating costs, corrosion hazards, reliability, residue, and environmental impact.

METHOD: Pyrolysis

The destructive distillation of organic wastes in an oxygen deficient atmosphere is called pyrolysis. Two full scale systems (200 TPD) have been built and operated. One system used pure oxygen and produced a 370 BTU/SCF gas that can be transported but is not being actively marketed at this time. The other system uses preheated air and produces a 100 BTU/SCF gas that is not transportable and is used directly in a boiler. Smaller systems have been developed and operated with some success, but there is no commercialization at this time. Gas production appears the simplest and most likely development and is discussed below.

	PRO	CON
ECONOMIC	There is a large demand for the gas produced since it can be substituted for natural gas in industry with minimum modification. The gas produced may possibly be converted into high value hydrogen, methanol, methane, or ammonia (some are readily transported and all are derived almost exclusively from natural gas). Has the least net cost of all options examined when implemented in large scale and used for high value chemical feedstock products. Can supplement costly fossil fuels.	Capital intensity plus high operating costs make this an expensive energy option. Market analysis for high value products is not complete due to complexity. The gas is not economically storable. Lower cost systems may evolve, especially from coal gasification technology.
ENVIRONMENTAL	No major air pollution problems expected. Further testing is planned. Reduces volume of landfill requirements by 80-95 percent. Slagging system produces totally inert residue. Energy recovered is greater than processing requirements.	System waste water discharges requires extensive treatment. Gas produced is toxic and unsuitable for domestic use. Conversion efficiency is lower than direct combustion.
TECHNOLOGICAL	Combustion of gas (such as boilers) is state-of-the-art; conversion to chemicals may have unquantified development.	Conversion of the gas to high value products has not been demonstrated. Use of the system in a large scale operation has not been demonstrated.
IMPLEMENTABILITY	The high marketable products may attract financing. Market for gas is available. Equitable distribution of benefits is achieved by conserving natural gas for residential use.	Capital intensity and high operating cost mandates assured waste flow and product utilization. Requires large systems for economy and large quantities of dilution water for sewage treatment.

CONCLUSION

Pyrolysis appears to be the best potential alternative environmentally, and may become economically competitive with direct combustion as fuel prices and availability change. However, limited knowledge of present markets requires further analysis to verify the economic viability of producing the high value products and to determine an optimum product mix.

CALIFORNIA STATE RESOURCE AGENCY MATERIALS FOR CLASSROOM TEACHERS

FOR USE IN TEACHING ABOUT THE NATURAL ENVIRONMENT

Title: **Be Careful with Our Stately Treasures**
Description: A colorful poster showing each state's tree (limited printing).
Topic: Plants
Grade Level: 4-6
Agency: State Department of Forestry

Title: **Don't Join the Bucket Brigade, Leave Tide Pool Life Alone!**
Description: Poster; good for elementary and adult.
Topic: Ocean life
Grade Level: K-12
Agency: State Department of Fish and Game and the University of California Sea Grant Program

Title: **Endangered Wildlife of California**
Description: A timely booklet, well illustrated, describing endangered wildlife in California. It also lists rare and extinct species in California as well as a federal list of California endangered species.
Topic: Endangered species
Grade Level: K-12
Agency: State Department of Fish and Game

Title: **Fish, Wildlife, and Plant Species in California Designated Endangered or Rare**
Description: A listing of species rare or endangered in California.
Topic: Endangered species
Grade Level: 6-12
Agency: State Department of Fish and Game

Title: **Geology of Placer Deposits**
Description: A booklet detailing methods and techniques which can be useful in discovering gold-bearing placer deposits.
Topic: Geology
Grade Level: 10-12
Agency: State Department of Conservation

Title: **Marine Mammals of California**
Description: This booklet begins with a comprehensive description of the various modifications of marine animals and of the Order Letacea. Whaling and whale conservation, and the Marine Mammal Protection Act are also explained. The bulk of the publication illustrates and describes 34 of the marine mammals seen or identified near California.
Topic: Marine mammals
Grade Level: 6-12
Agency: State Department of Fish and Game and the University of California Sea Grant Program

Title: **Species Booklets**
Description: A series of 12 booklets offer information on many California fish and game species as well as nongame species. All have photographs and/or drawings identifying species. Descriptions of habitat, natural history, and distribution are also included.
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **The California Gray Whale**
Description: A brochure with excellent color photographs. Content covers biology of the gray whale, the migration, endangered status, and guidelines for whale watching.
Topic: Gray whale
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **Thanks to You We Still Have a Home**
Description: A colorful poster showing a variety of birds on vegetation representative of their environment (limited printing).
Topic: Animals/birds
Grade Level: K-6
Agency: State Department of Forestry

Title: **The Plants and Animals of Folsom Lake**
Description: A detailed guide to the diverse natural communities surroundig Folsom Lake State Recreational area.
Topic: Plants and animals
Grade Level: 10-12
Agency: State Department of Parks and Recreation

Title: **Wildlife Leaflets**
Description: Excellent one-page leaflets, each dealing with a single species of wildlife. Almost all familiar vertebrates are described.
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **Wildlife—The Environmental Barometer**
Description: A pamphlet detailing the importance of a healthy environment for wildlife and the potential harm of man-made changes. Details harmful changes caused by man which may affect all of life, including man. "By saving wildlife man may save himself."
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

FOR USE IN TEACHING ABOUT THE BUILT ENVIRONMENT

Title: **A Description of the Set of Minerals and Rocks Furnished to California Schools by the California Division of Mines and Geology**
Description: A pamphlet filled with photographs and excellent chemical descriptions of minerals as well as a discussion of their economic worth and where they can be found in California.
Topic: Geology
Grade Level: 4-12
Agency: State Department of Conservation

Title: **Simplified Geologic Map of California**
Description: A postcard to commemorate the state centennial. Color coded to indicate age and rock type.
Topic: Geology
Grade Level: 4-12
Agency: State Department of Conservation

FOR USE IN TEACHING ABOUT SOCIAL INSTITUTIONS AND DECISION MAKING

Title: **Adventures in Public Transit**
Description: The learning activities are geared to Orange County but the format could be used elsewhere. The activities are approached as a "magic window experience" with firsthand observations to see, do, record, evaluate, and value.
Topic: Transportation
Grade Level: 6-8
Agency: State Department of Transportation

Title: **Checklist for You and the Environment**
Description: This brochure sets forth simple, everyday methods by which all Californians can reduce waste.
Topic: Waste reduction
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Closing the Loop***
Description: This filmstrip describes the "hows" and "whys" of recycling.
Topic: Recycling
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Composting**
Description: This slide show describes the process which diverts organic wastes from landfills and yields a rich soil amendment.
Topic: Composting
Grade Level: 7-12
Agency: Solid Waste Management Board

*Filmstrips also available as slide shows

Title: **The Davis Experience**
Description: A reprint from *Solar Age* (May 1978) describing the Davis energy study, their energy building code, and city planning strategies that maximize the use of solar energy.
Topic: Solar energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Estimating Utilities' Prices for Power Purchases from Alternative Energy Resources**
Description: A technical report that estimates the future costs of conventional energy resources so that cost comparisons with renewable and decentralized energy resources can be made in a more economically competitive manner. The information presented is an interesting case study of the role of the economic forecasting in present energy investment decisions. Includes data on California's electricity supply by fuel type and estimated costs of generating electricity with a variety of fuel types.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Fact Sheets** (single items available for reproduction)
Description: A series of information bulletins covering a wide range of solid waste management topics: waste reduction, oil recyling, recycling, composting, the Solid Waste Management Board, waste to energy, glossary of solid waste management terms, citizen action for a waste-efficient California.
Topic: Waste management
Grade Level: 10-12
Agency: Solid Waste Management Board

Title: **The Garbage Crisis** (teacher background information)
Description: This brochure gives overview of the Solid Waste Management Board's activities statewide for 1980.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Great American Wild Waste Show**
Description: Videotaped vaudeville performance by the Twelfth Night Repertory Company. Teaches four "R's" of solid waste management—reduce, reuse, recycle, recover.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Industry Recycles***
Description: This filmstrip describes current methods of recycling employed within various California industries.
Topic: Recycling
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Joint Investigation by the California Energy Commission and the California Public Utilities Commission into the Availability and Potential Use of Solar Energy in California**
Description: A technical report that outlines the desirability of using solar energy for domestic water heating and passive space heating useful as a benchmark in studying the history of solar- legislation in California. Recommendations for inc ives utilities can use to motivate their customers to use solar energy are outlined. This publication can be used as a checklist of the progress made by the utilities in carrying out the recommendations listed.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Passive Solar Design—Here and Now**
Description: Details and pictures various architectural designs which promote the collection, storage, and use of solar energy. Explores historical ways passive solar energy was used by the Greeks and Romans, the Mesa Verde Indians, and the residents of New England. Good discussion of the various ways that heat moves. Illustrates the effectiveness of passive systems and the importance of energy conservation.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Salvaging Demolition Waste**
Description: This slide show details innovative reuse and recycling of construction and demolition debris.
Topic: Salvaging
Grade Level: 6-12
Agency: Solid Waste Management Board

Title: **Saving Energy at Home—It's Your Money**
Description: Pamphlet illustrating how energy can be conserved at home.
Topic: Energy conservation
Grade Level: 6-12
Agency: California Energy Commission

*Filmstrips also available as slide shows

Title: **Solar Water Heaters in California 1891-1930**
Description: A magazine-type publication describing the use of solar energy to heat water. The technology is not as new as some people imagine.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Solid Waste Management Resource Persons** (for large assembly presentations)
Description: Speakers available for presentations on variety of solid waste management topics: State Solid Waste Management Board, duties and functions; California's garbage crisis, controlling litter, waste reduction, resource recovery, recycling, salvaging and demolition wastes, and composting.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Solid Waste Posters**
Description: Set of seven colorful posters depicting the good, bad, hilarious and silly ways in which we operate and simple "do-able" ways for us to change for the better: "Great Garbage Machine," "Technology!" "Why Recycle?" "Buyer Be-Aware!" "Recycling Is for Everyone!" "Running Out/Running Over!" "Garbage Is What You Throw Away!"
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **State Solid Waste Management Board**
Description: This slide show gives an overview of California's Solid Waste Management Board membership, history, and functions.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Transportation Alternatives—Student Handbook**
Description: A booklet which presents the modes of transportation. It can be used at home to do a self-transportation survey along with family involvement.
Topic: Transportation
Grade Level: 3-7
Agency: State Department of Transportation

Title: **Trash Monster**
Description: Interdisciplinary, two-week environmental education unit. Teaches students resource conservation skills. Complete sets of materials and procedures provided.
Topic: Waste management
Grade Level: 5-7
Agency: Solid Waste Management Board

Title: **Waste Reduction—A Consumer Action**
Description: This slide show is an examination of consumption/throw-away habits and simple, everyday measures to combat waste.
Topic: Waste reduction
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Waste-To-Energy***

Description: This filmstrip describes the evolving technology of waste utilization as a resource to fill California's growing energy needs.

Topic: Energy

Grade Level: 7-12

Agency: Solid Waste Management Board

Title: **Wildlife—The Environmental Barometer**

Description: A brochure describing how wildlife can be used to assess the health of the environment.

Topic: Wildlife

Grade Level: 10-12

Agency: State Department of Fish and Game

Title: **Wizard of Waste**

Description: An interdisciplinary, two-week environmental education unit. Teaches students resource conservation skills. Complete sets of materials and procedures provided.

Topic: Waste management

Grade Level: 2-4

Agency: Solid Waste Management Board

*Filmstrips also available as slide shows

FOR USE IN TEACHING ABOUT RESOURCE MANAGEMENT

Title: **A Guide to the Urban Water Conservation Garden**

Description: This brochure gives valuable information for planting a variety of gardens (rock gardens, shrub beds, vegetable gardens, etc.) on one side; the other side is a poster of a model garden.

Topic: Water conservation

Grade Level: K-12

Agency: Department of Water Resources

Title: **An Introduction to the Energy Resources of California**

Description: A comprehensive "primer" on nonrenewable energy resources: oil gas, and geothermal. It includes a description of the geology of petroleum deposits and the various steps needed to produce oil from drilling to refining. A fold-out map of California shows the known petroleum and geothermal deposits.

Topic: Petroleum/Energy/Geology

Grade Level: 10-12

Agency: State Department of Conservation

Title: **A Pilot Water Conservation Program**

Description: A 1978 publication describing the Department of Water Resources public outreach program on water conservation during the drought. Specific water conserving devices and habits are outlined and the public's response to implementing water conservation strategies is discussed.

Topic: Water conservation

Grade Level: 7-12

Agency: State Department of Water Resources

Topic: **California Solar Information Packet**
Description: A pamphlet illustrating basic solar design principles, passive solar applications, and active solar systems.
Topic: Solar energy
Grade Level: 7-12
Agency: State Energy Commission

Title: **Decade of the Sun. Program for Maximum Implementation of Solar Energy through 1990**
Description: An excellent overview of California's Solar Program present and future, a review of the state-of-the-art of various solar technologies, potential electric energy savings with solar.
Topic: Energy/Solar
Grade Level: 10-12
Agency: California Energy Commission

Title: **Domestic Solar Water Heating—A Builder's Guide**
Description: A pamphlet describing the basic components of a solar domestic water heating system with illustrations.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Energy Farming**
Description: A study of plant crops which could be used as a biomass for fuel. Economics of energy farming is discussed in conjunction with varied energy conversion routes and products from biomass.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

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Title: **Environmental Impact Report for California Energy Commission Solar and Wind Programs**
Description: An excellent overview of the state's wind and solar programs describing the technologies, their impacts on air and water quality, and the potential of the resource for displacing nonrenewable energy resources.
Topic: Energy/Wind
Grade Level: 10-12
Agency: California Energy Commission

Title: **Excerpts from State Fire Laws Applicable to Forest Fire Prevention**
Description: A small pamphlet describing the fire permit process, techniques for fire hazard reduction, and penalties and liabilities related to behavior during forest fires.
Topic: Forest fires
Grade Level: 7-12
Agency: State Department of Forestry

Title: **Fire Hazard Reduction**
Description: A one-page handout diagramming the techniques for reducing fire hazards around a forest dwelling, as well as plans for building a chimney spark arrester.
Topic: Fire protection
Grade Level: 7-12
Agency: State Department of Forestry

Title: **Fireproof Your Forest Home**
Description: A small brochure with photographs showing how to clear the area around a structure to help prevent it from burning in case of a forest fire.
Topic: Fire prevention
Grade Level: 4-6
Agency: State Department of Forestry

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Title: **Fire. Will Your Home be Next?**
Description: Pamphlet describing steps to take to reduce fire hazards to a structure by 70 percent.
Topic: Fire prevention
Grade Level: 7-12
Agency: State Depatment of Forestry

Title: **Handbook on California Natural Resources**
Description: An informational guide to the development and maintenance of programs in natural resource use and conservation. Good basic information on soil, water, minerals, air, plant, and animal life.
Topic: Natural resources
Grade Level: 8-12
Agency: State Department of Conservation

Title: **Hints for Water Conservation**
Description: An information bulletin outlining home water conservation strategies.
Topic: Water conservation
Grade: 4-6
Agency: State Department of Water Resources

Title: **Impact of Severe Drought in Marin County, California**
Description: A 1979 publication that outlines the effects of water shortage on residences, businesses, and livestock ranches. Contains many figures and tables of water use data. A good case study for secondary use.
Topic: Drought
Grade Level: 7-12
Agency: State Department of Water Resources

Title: **Joint Investigation by the California Energy Commission and the California Public Utilities Commission into the Availability and Potential Use of Solar Energy in California**
Description: A technical report that outlines the desirability of using solar energy for domestic water heating and passive space heating. Useful as a benchmark in studying the history of solar-related legislation in California. Recommendations for incentives utilities can use to motivate their customers to use solar energy are outlined. This publication can be used as a checklist of the progress made by the utilities in carrying out the recommendations listed.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Save Energy**
Description: A survey of current activities in energy management of local, statewide, and national significance. Articles highlight CEES activities of local community groups, grant and utility programs, local government options, and state agencies working in energy. Each issue usually contains a policy piece and reproducible reference feature.
Topic: Energy management programs and policy
Grade Level: Designed for decision makers. Would be useful in high school as well.
Agency: California Energy Extension Service

Title: **Save Water**
Description: A graphically pleasing brochure outlining water conservation techniques. A good succinct introduction for use at all levels, including primary.
Topic: Water conservation
Grade Level: K-12
Agency: State Department of Water Resources

Title: **Solar Here and Now**

Description: A pamphlet detailing active and passive heating techniques.

Topic: Solar energy

Grade Level: 6-12

Agency: California Energy Commission

Title: **Solar Installers Training Manual**

Description: Over 200-page curriculum of domestic hot water systems, pool systems, and space heating systems. Manual is accurate, complete, and extremely practical and is currently used in over 15 training programs.

Topic: Training for solar installers

Grade Level: High school

Agency: SolarWork Institute, California Energy Extension Services (CEES)

Title: **Solar Pool Heating**

Description: A pamphlet illustrating how solar heats pool water and how the water cools off. Pool covers are discussed along with other ways heat may be conserved. Good information on collectors, collector tilt and sizing, controls, mounting the collectors; maintenance and installation are also covered.

Topic: Solar energy

Grade Level: 7-12

Agency: California Energy Commission

Title: **Synthetic Oil vs. Methanol as a Liquid Fuel Product from Waste Conversion Processes**

Description: A technical report describing the processes by which municipal, agricultural, and forestry wastes can be converted into ethanol or methanol, and a discussion of the ways ethanol and methanol can be used to substitute for gasoline, natural gas, or diesel oil in combustion turbines for generating electricity as fuel for automobiles and as a fuel for boilers.

Topic: Energy from municipal, agricultural, and forest wastes

Grade Level: 10-12

Agency: California Energy Commission

Title: **The LNG Decision in California: Reliability, Cost, Safety, and Siting**

Description: Good resource describing LNG world trade routes, facilities, and terminals with numerous charts and tables relating to LNG cost, safety, and siting.

Topic: Energy/LNG

Grade Level: 10-12

Agency: California Energy Commission

Title: **Urban Forestry**

Description: A four-page pamphlet dealing with planting trees in urban areas. Urban forestry projects are described which could be duplicated by a class.

Topic: Trees

Grade Level: K-12

Agency: State Department of Forestry

Title: **Water Conservation in California**

Description: A 1976 publication describing water uses in California. Water conservation strategies for residences, businesses, and agriculture are outlined. Many figures and tables are included.

Topic: Water

Grade Level: 7-12

Agency: State Department of Water Resources

Title: **Water Pricing**

Description: An information bulletin describing water pricing strategies that can encourage water conservation.

Topic: Water conservation

Grade Level: 10-12

Agency: State Department of Water Resources

Title: **Water Saving Planting Ideas** (reprinted from *Sunset* magazine)

Description: An informative article describing drought-tolerant or drought-resistant plants for California gardens.

Topic: Water conservation

Grade Level: 7-12

Agency: Department of Water Resource

Title: **Wind-Electric Power, A Renewable Energy Resource for California**

Description: An overview of the use of wind in California to generate electricity. Includes a map of high-wind areas in the state and a summary of the California wind program through 1978. (This can be updated with more current information from the ECE Wind Office.)

Topic: Energy/Wind-Electricity

Grade Level: 10-12

Agency: California Energy Commission

RESIDENT OUTDOOR EDUCATION

Resident outdoor education programs are based on three ingredients for effective learning: a specific body of content, firsthand experience, and personal identification with the affective goals of the program. As the name implies, outdoor education takes place outdoors in the natural environment. The setting is a laboratory where firsthand observations provide the examples that lead to discovering and confirming the scientific principles on which the program is based. Personal verification of facts, principles, and aesthetic appreciation is at the core of every learning experience. Since the environment is teacher and textbook, the group leader is free to act as a resource person and carry on a dialogue with students, exchanging observations and ideas, making generalizations based on multiple observations, and expressing the feelings and appreciation that a close study of the natural environment evokes.

Outdoor settings are generally crowded with interesting things to observe and think about. Students are easily involved with the content of the setting. This makes it possible for the leader to move easily from working with individuals, to small groups, or the total group. Independence and personal responsibility are emphasized in making observations, initiating dialogues, exchanging ideas, and assuming responsibility for learning.

The natural environment is an optimal setting for developing positive attitudes about the relationship of self to the environment. Examples of cause and effect relationships are available everywhere. There is immediate feedback on the consequences of human action on the environment. Within this context, students can develop a sense of personal responsibility in caring for the environment.

Recognition of the inherent beauty in an outdoor setting brings a richness to our lives that is beyond words. The multitude of living things—plants and animals—in the natural environment can be used to build a respect for the preciousness of life. The variety of forms living in harmony and for mutual benefit in a small area of the environment are representative of the principles that govern all of nature.

California public schools are fortunate to have access to a variety of resident outdoor school programs. Because these programs are an integral part of environmental education, a directory of city and county programs follows:

City and County Resident Outdoor Education Programs

Fresno County
Chuck Kaylor
Regional Learning Center
Route 3, Box 530
Sonora, CA 95370
(209) 532-3691

Glenn County
Ralph Herman
525 West Sycamore
Willows, CA 95988
(916) 934-7011

Humboldt County
Cheryl Christiansen
901 Myrtle Avenue
Eureka, CA 95501
(707) 445-7611

Kern County
Ben Bird
5801 Sundale Avenue
Bakersfield, CA 93309
(805) 834-3700

Lake County
Gerald DeFries
P.O. Box 457
Boonville, CA 95433

Los Angeles Unified
Durrell Maughan
3317 Bellevue Avenue
Los Angeles, CA 90026
(213) 625-6000

Los Angeles County
9300 East Imperial Hwy.
Downey, CA 90242
(213) 922-6334

Long Beach Unified
701 Locust Avenue
Long Beach, CA 90813
(213) 436-9931

Marin County
201 Tamal Vista Blvd.
Corte Madera, CA 94925
(415) 924-9500

Monterey County
J. P. Van Ettinger
P.O. Box 851
Salinas, CA 93901
(408) 424-0654

Orange County
P.O. Box 15029
Santa Ana, CA 95705
(714) 953-3900

Sacramento County
Glenn Davis
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